SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY 1906.

GENERAL PHYSICS.

1. *Boomerang for the Lecture-room.* **L. Pfaundler.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 647–648, May, 1905.)—Small boomerangs of various shapes, and 6 to 10 cm. long, are cut from aluminium-foil 0·5 mm. thick, and hammered convex on one side. These are placed on a small table so that the concave edge is to the front, and one end projects over the side of the table almost on a level with the top of a flat, vertical steel spring used for propelling the boomerang by hitting the projecting end. The boomerang shoots forward and upward for a distance of 5 to 6 m., and then returns almost to the starting-point. The boomerang is gradually deformed by the repeated percussion of the spring. G. E. A.

2. *Rotation Oil Air-pump.* **K. T. Fischer.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 383–390, Oct. 30, 1905. Paper read before the 77 Naturforscher-versamml. at Meran, Sept. 28, 1905. Phys. Zeitschr. 6. pp. 868–871, Dec. 1, 1905.)—The pump described is made by the firm Siemens-Schuckert, and is of the continuous-rotation type. For the production of very high vacua two pumps in series are employed, a pressure of 0·00015 mm. Hg being the lowest that can be obtained by this arrangement. The pump can extract 80 litres of air at atmospheric pressure per min. when motor-driven at 400 r.p.m., but when hand-driven the maximum rate is 200 r.p.m. With a single pump the limiting pressure is 0·015 mm. Hg, the vapour pressure of the oil. S. G. S.

3. *Bending of Straight Beam.* **H. Zimmermann.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 44. pp. 898–912, Nov. 9, 1905.)—The problem here solved is that of a straight beam which may or may not be laterally supported, and which is subjected to a stress acting in the direction of the axis. The treatment is entirely mathematical, the differential equation of the curve into which the beam is bent being obtained and solved, the three following assumptions being made: (i.) the change of shape produced by the axial stress is so small in comparison with that produced by bending that it may be neglected, and $(dy/dx)^2$ may be neglected in comparison with unity; (ii.) the cross-section is uniform, or only changes suddenly; (iii.) the elasticity of the material is uniform, and the lateral support is either uniform or varies suddenly. There are three forms to the solution, according as $\left(\frac{S}{2EJ}\right)^2 \gtreqless \frac{p}{EJ}$ where S is the axial force, E the elasticity of the material, J the moment of inertia of the cross-section, and p the lateral supporting force per unit length produced by unit bending. In the first case the curve is a simple function of $\sin\sqrt{S/EJ}\,x$ and $\cos\sqrt{S/EJ}\,x$, but in the other two cases the functions are not simple sines and cosines. Two practical cases are discussed; the first being one in which the longitudinal force is parallel to the axis but not coincident with it, while in the second it is coincident with it. In both cases the cross-section is uniform. The solutions are obtained. S. G. S.

4. *Loss of Velocity and Energy of Shots in Water.* **M. Gildemeister** and **H. Strehl.** (Ann. d. Physik, 18. 3. pp. 567–578, Nov. 21, 1905. Physiolog. Inst., Königsberg.)—In the experimental work described the method of Radakovič for determining the velocities was followed. A Mauser pistol was used, firing steel-cased shot of 5·5 gm. weight. The velocity on entering and leaving the water was measured, the water being contained in a strong tin cylinder 10 cm. long and 15 cm. diam.; the ends of the cylinder were closed with parchment fastened on with gum. Both ends bulged on filling, so that the thickness of water traversed by the shot was about 13 cm. Tables are given showing the velocity on entering and on leaving, and the loss of velocity and energy are also shown.

Velocity on Entering. m./sec.	Energy. kg.-m.	Velocity on Leaving. m./sec.	Energy. kg.-m.	Velocity-Loss. m./sec.	Energy-Loss. kg.-m.
445·7	55·7	398·3	44·5	47·4	11·2
368·2	38·0	329·4	30·4	38·8	7·6
312·3	27·3	283·1	22·5	29·2	4·8
266·9	20·0	240·5	16·2	26·4	3·8

From these results the authors conclude that the loss of velocity of shots in water is proportional to the first power of the velocity on entering, and the loss of energy to the second power. Kurlbaum's theoretical formula is discussed, and numerical values are assigned to the constants. Measurements were also made of the loss of velocity for different thicknesses of water with the same entrance velocity, and the conclusion is drawn that the velocity-loss of a shot in passing through an infinitely thin layer of water is proportional to the entrance velocity. [See also Abstracts Nos. 6 and 8 (1901).] A. W.

5. *Temperature Variation of Young's Modulus.* **A. Wassmuth.** (Phys. Zeitschr. 6. pp. 755–756; Discussion, p. 756, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—Deals with determinations, by bending metal bars [see Abstract No. 1021 (1903)], of the thermal change ϵ of the Young's modulus E, where $\epsilon = (1/E)\,dE/dT$. The following values of ϵ were found:—

Metals.	$\epsilon \times 10^4$.	Metals.	$\epsilon \times 10^4$.
Steel	2·33 to 2·41	Platinum	0·978
Copper	3·64	Silver	7·48
Gold	4·32	Zinc (inferred from alloys)	35

E. H. B.

6. *Strength and Elasticity of Brickwork.* **W. C. Popplewell.** (Inst. Civil Engin., Proc. 161. pp. 311–331, 1904–1905.)—Records the results of compression tests on brickwork columns about 1 ft. 6 in. square by 8 ft. high. Elastic strains were measured by a form of Martens' mirror extensometer. Stresses and strains were found to be proportional beyond loads used in practice. Upon repeated loading the modulus gradually increased, possibly owing to the interstices becoming closed. The elastic properties of brickwork depend more on the quality of the mortar than on that of the bricks; besides its elasticity in the horizontal joints, its adherence in the vertical is of value. For the numerical results reference should be made to the paper. F. R.

7. *Determination of the Isentropic Compressibility of Liquids.* **W. Schmidt.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 945–991, July, 1905. From the II. physikal. Inst. d. k.k. Univ., Wien.)—Into a vertical glass tube, closed at the lower end and supported at the middle, is poured some liquid, and the tube is put into longitudinal vibration by friction. The resulting note depends on the nature and depth of the liquid as well as on the tube, and from the observed vibration-frequency, by a theory which is discussed at length in the paper, the velocity of sound in the liquid is determined and thence the compressibility. The liquids examined were distilled water, absolute alcohol, ether, benzine, CS_2, aqueous solutions of various concentrations of eleven different salts, the common acids HCl, HNO_3, H_2SO_4, of various strengths, and mastic emulsions. In all cases except the last the compressibility increases with diminution of the concentration, while in the emulsions it exhibits a minimum value. For variations of temperature the compressibility shows a minimum value with water and aqueous solutions, but for benzol, solutions of naphthalin in benzol, and the oils of turpentine and vaseline, it rises with the temperature. R. E. B.

8. *Catgut Strings.* **J. R. Benton.** (Amer. Journ. Sci. 20. pp. 388–391, Nov., 1905.)—This paper deals with tests of the mechanical properties of the catgut strings used on musical instruments, most of the experiments being carried out with a violin E-string. The results are briefly as follows: Elongation at rupture 15 to 19 per cent. of original length. Tensile strength 43 kg. per sq. mm., or 60,000 lbs. per sq. in., as against wood 20,000 lbs. per sq. in., leather 5,000, and hemp ropes 15,000. Length of a given string and the relative humidity of the air being simultaneously observed and plotted as functions of the time show: (1) Increase of length with increased humidity, and (2) a time lag of length-increase after the increased humidity to which it is due. Young's modulus has a value 322 kg. per sq. mm., or 458,000 lbs. per sq. in. It was also sought to determine the coefficient of thermal expansion. This appeared to be negative, but the results were probably more a matter of humidity than thermal effects pure and simple. E. H. B.

9. *Theory of Tube Mill.* **H. A. White.** (Chem. and Metallurgical Soc. S. Africa, Journ. 5. pp. 290–303; Discussion, pp. 303–305, May, 1905.)—The paper gives a mathematical discussion of the subject, besides descriptions and numerous illustrations of experiments carried out by the author. The diagrams and illustrations are one of the chief features, and should be consulted by those interested. The pulverising action in a tube mill is due almost entirely to actual impact of the falling balls in dry crushing, but where

the tube is half full of water it is probable that the grinding action between the balls does a great proportion of the work. In practice it is found that the linings constantly require attention; this might possibly be obviated to a large extent by increasing the speed until the outer layer of balls is continuous, thus forming a sort of automatic lining. In wet crushing as little water as possible should be in the mill, as much water diminishes the effective fall of the balls. In the *discussion*, **W. R. Dowling** said that this point was borne out by results obtained at the Robinson Deep Mine. The best results were obtained with water and ore in the proportion of 3 to 4. He also mentioned that a mill with silex lining took a larger feed and gave a finer ground product than one with a manganese-steel lining. A. W.

10. *Correction for Readings of a Spring Balance when used on a Slope.* **A. E. Young.** (Inst. Civil Engin., Proc. 161. pp. 258–260, 1904–1905.)—The correction used in the U.S. Coast Survey for the readings of a spring balance used horizontally is extended for any slope θ with the horizon; it is—

$$\tfrac{1}{2}[(W - R)(1 - \sin\theta) - r(1 \mp \sin\theta)]$$

additive, W being the weight of the balance, R its reading when suspended vertically by its hook, r the index correction for the normal position, and the upper or lower sign being taken according as the slope is up or down. R. E. B.

11. *Prevention of Swing of a Pendulum Support.* **A. Prey.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 993–1000, July, 1905.)—Faye's suggested arrangement for this purpose, viz., by simultaneously and freely swinging an exactly similar pendulum from the support, and in the same plane but always in opposite phase, fails in actual practice from irregularities which cause one pendulum invariably to gain on the other. The author proposes to drive this second pendulum mechanically by means of a stud projecting sideways from the rim of a uniformly revolving wheel and engaging in a slot cut lengthwise in the pendulum: the oscillation thus produced is very nearly the same as if the pendulum swung freely. Continuous regulation of the rotation of the wheel is necessary, however, in order to ensure exact opposition of the swings. R. E. B.

12. *Origin and Growth of Ripple-mark.* **Mrs. Hertha Ayrton.** (Roy. Soc., Proc. 74. pp. 565–566, April 10, 1905. Abstract.)—As regards the starting of ripple-mark in perfectly smooth sand, it was found that a single ridge forms wherever water happens to have a place of maximum longitudinal velocity during several oscillations. As soon as this ridge reaches a certain height (less than 1 mm.) the water in flowing over it forms a spiral vortex with horizontal axis, which starts a new furrow and ridge in the lee of the first, on one side during one swing, and on the other side during the next. Vortices arise at these two new ripples and give rise to fresh ripples. When the place of maximum horizontal velocity was constant, not merely for several oscillations but for a considerable time, as at the loop, for horizontal motion, of a stationary wave, the ridge formed grew into a ripple-marked heap which was highest at the loop and lowest at the nodes. By oscillating water in the simplest possible way, so that it alternately rose and fell at one end of the trough while it alternately fell and rose at the other, a stationary wave having its length twice the length of the trough was obtained; and in this case a ripple-marked mound arose of which the apex was at the middle of the trough —one loop of the wave—and the lower parts were near the ends—the two nodes. When the stationary wave was of the same length as the trough, two mounds arose, one near each end; and so on.

The author suggests that the tidal ridges in estuaries and the chains of sandbanks under the sea are formed in this way, by stationary or nearly stationary water waves; and that the sand dunes of the seashore and of the desert, and the clouds in a "mackerel sky," may be similarly the products of stationary air-waves. A. F.

13. *Diffusion of CO_2 through Indiarubber.* **L. Grunmach.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 355–367, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 795–800, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—Many determinations of the rate of diffusion of CO_2 through very thin layers of indiarubber have been made, but in this paper sheets up to 2·4 mm. in thickness are used. A hemispherical glass vessel is cemented over the sheet of rubber and the vessel filled with CO_2. The rate of diffusion is determined by measuring the gas pressure in the vessel after various intervals. The alterations in area and thickness due to the bending in of the sheet as the pressure falls, are allowed for. The author finds that the rate of diffusion increases with increase of the difference of the partial pressures of CO_2 on the two sides of the sheet, but is not proportional to it; it depends upon the absolute pressure, as well as upon the difference of pressures. Further, the diffusion is not inversely proportional to the thickness of the sheet. It is pointed out that great differences in quality exist in the specimens of rubber used, and hence the desirability of continuing the experiments with pure Para rubber. S. G. S.

14. *Nuclei in Dust-free Air.* **C. Barus.** (Amer. Journ. Sci. 20. pp. 297–300, Oct., and pp. 448–453, Dec., 1905.)—In the fog chamber used the coronal condensation began at a pressure difference of about $\delta p = 26$ cm. In the experiments described the tests were made at $\delta p = 41·5$ cm., and the approximate number of nuclei found in the dust-free air was about 380×10^3 to 400×10^3 per cm.^{3}, these nuclei being exceedingly small, much smaller than ions. When the fog chamber is subjected to the γ-rays from weak radium contained in a thin Al tube, the radium being gradually moved up from a distance towards the end of the chamber, which was 1 cm. thick, the number of efficient nuclei in the dust-free air contained is gradually but enormously reduced to a minimum for an axial distance $D = 25$ cm. (about) between the radium and the end of the chamber, after which the number again increases to the maximum at $D = 0$. The cause of the minimum is explained by the fact that the ions are relatively large bodies, and relatively few in number compared with the nuclei of dust-free air. Hence the ions capture the moisture more and more fully as their number with diminishing distance D becomes greater. At $D = 25$ cm. probably the whole of the moisture is condensed on ions, and as their number increases as D vanishes the minimum in question results. There is observed a suggestive occurrence of a continuous succession of groups or gradations of nuclei, each of which groups constitutes a condition of chemical equilibrium for the given radiating environment. The nuclei of dust-free air are an essential part of this body as much as the molecules themselves. Such nuclei if withdrawn by precipitation are at once restored. Again, air left without interference for days

shows a maximum of this nucleation for the given conditions of exhaustion when all foreign nucleation must have vanished. Indeed, the molecules themselves may be treated as a continuous part of the nucleation in question, the frequency of occurrence being a maximum for the molecular dimensions. Furthermore, in the presence of radium the character of the phenomenon is the same, only the nuclei are larger. The effect of radium, however distant, is always virtually an increase of the size of the air nuclei and a decrease of their number. In the second paper tables and diagrams are given illustrating the relations of ions and nuclei. J. J. S.

15. *Nuclei and Ions.* **L. B. Joslin.** (Science, 22. pp. 762–764, Dec. 8, 1905.)—Dust-free moist air contained within a glass fog chamber was acted upon with a sample of weak radium, which was placed in contact with the outside of the walls of the chamber and removed suddenly at given intervals before exhaustion. The action of β- and γ-rays only was in question. The effect of the radiation appears to be a coagulation of the colloidal nuclei into the aggregates much larger in size representing the ions. Above the fog limit of dust-free air the number of efficient nuclei must increase with the removal of radium at a rate which corresponds to the falling-to-pieces of the ions. A feature of the results is the manner in which the efficient nucleation decays from the coarser ionised to the finer non-ionised colloidal stages, when the pressure difference is decidedly above the fog limit of air, so that the latter may be recognised. The curves showing the relation between number of nuclei and time of decay invariably pass through a minimum when the interval of decay, or time after the removal of the radium, increases indefinitely. This minimum is very sharp, almost cusp-like, as if one law were passing abruptly into another. The curves as a whole have a close resemblance to those given by Barus for the effect of radium at different distances from the fog chamber. [See preceding Abstract.] J. J. S.

16. *Surfaces of Discontinuity in a Rotationally Elastic Medium.* **T. H. Havelock.** (Phil. Mag. 10. pp. 603–613, Nov., 1905.)—A mathematical treatise on the above subject, with special reference to the æther as a rotationally elastic medium. It is shown that a discontinuity of the second order is propagated in the medium as a wave-front moving with a constant normal velocity. In dealing with first-order discontinuities, it is shown that under certain conditions a persistent wave-front, consisting of a first-order discontinuity separating two states which are compatible up to the second order, is propagated in the medium with constant normal velocity. Also in this case the two vectors representing the discontinuities in the electric and magnetic forces are at right angles to each other and lie in the wave-front. Further, it is shown that the discontinuity in the Poynting radiation vector is in a direction normal to the wave-front and of a magnitude equal to the square of the discontinuity in the magnetic force. E. H. B.

17. *Surface Tension of Solidified Mercury.* **M. Petrova.** (Jurn. Russk. Fisik.-Chimičesk. Obščestvá, 37. No. 7. Physical Part, pp. 203–206, 1905.)—The image, magnified 7 times, of a drop of mercury resting on a plate of glass has been photographed both before and after solidification by a mixture of solid carbonic acid and ether; on superposing the photographic images, it was found that there was no appreciable difference between the images. D. H. J.

18. *Surface Tension of Mercury in Contact with Solutions.* **M. Lenkewitz.** (Beibl. Ann. d. Physik, 29. 8. p. 395, 1905. Extract of Dissertation, Münster, 1904.)—The image of a drop of mercury is projected on to a screen, the magnification being 10. The height and diam. of the drop are measured and the surface tension calculated. The liquids used in contact with the mercury are water, alcohol, and solutions of KCl, NaCl, K_2SO_4, Na_2SO_4, H_2SO_4, HCl, $K_2C_2O_4$, $CuSO_4$, $ZnCl_2$, NaOH, CH_3COONa, PO_4HNa_2. In a second set of experiments it is shown that the surface tension, as measured by the capillary tube method, is independent of the diam. of the capillary tube used. S. G. S.

19. *Rain Showers, and a New Method of Rain Measurement.* **W. Gallenkamp.** (Meteorolog. Zeitschr. 22. pp. 1–10, Jan., 1905.)—The author objects that the ordinary rain-gauges do not mark the fluctuations in the intensity of the rainfall during a shower, and he has therefore devised an apparatus which will record chronometrically each drop, and finally measure the total quantity. An **S**-shaped tube is attached to the bottom of the ordinary gauge cylinder; each drop falling on a tilting cup closes an electric circuit. The chronometrical part of the apparatus has not been constructed yet. But observing showers in India with the aid of a watch in 1894, the author noticed peculiar periodicities. The first short and slight fall of a shower is followed by a pause; then comes the main downpour, succeeded by a pause and a weaker fall. The phenomena would be in accord with the air waves, whirls, and breakers of Helmholtz. H. B.

20. *General Movements of the Atmosphere in Winter.* **P. Garrigou-Lagrange.** (Comptes Rendus, 141. pp. 283–285, July 24, 1905.)—Studying the weather charts of the Signal Office for the years 1882 and 1883 and for the whole of the northern hemisphere [as in Abstract No. 1268 (1904)], the author finds that, as a rule, the hemisphere may, in every season, be divided into four regions of unequal areas but symmetrical position; the barometer is high in two of these regions, and low in the other two. The principal movements consist in a union of the regions. After a period of from 5 to 8 days, the two maxima and two minima will have been reduced to one maximum and one minimum, and after a similar period there will again be four regions. In winter the maxima are continental, the minima oceanic. The locations change; in Siberia the maximum oscillates between north-east and south-west. H. B.

21. *Differences of Temperature with Varying Altitude.* **C. McLeod.** (Roy. Soc., Proc. Ser. A. 76. pp. 415–418, Aug. 4, 1905.)—By the aid of a British Association grant in 1897, a line was laid from the summit of Mount Royal, Montreal, to connect with the McGill College Observatory, in order to obtain continuous electrical records in the observatory with a Callendar recorder of the variations of temperature on the summit of Mount Royal at a distance of about a mile, in a situation which was inaccessible for the greater part of the winter. The air line first provided was injured by lightning, and the insulation proved very imperfect during the rainy season, and a lead-covered cable was therefore fitted in the summer of 1903. The length of this was 4,100 ft., the horizontal distance between the stations 3,300 ft., and the difference in altitude 620 ft. A pair of similar platinum thermometers, each having a resistance of 9·264 ohms at 32° F. and giving a scale of 1/5 in. per 1° F., were connected differentially to the recorder, one thermometer being placed in a screen on the top of the mountain at one end of the line, and the other in a similar screen near the observatory. The maximum error due to defective insulation or compensation or variation of zero did not exceed 0°·5 F. The results of the first year's working demonstrate the possibility of obtaining continuous records very accurately of the temperature of an inaccessible station without any trouble over long periods. Several of the records obtained are illustrated in the paper. If the differential records are compared with the temperature at the lower station, it is at once noticed that any marked change of temperature at the lower station is almost invariably preceded by a similar change at the higher station at an interval of time of about 12–24 hours. C. P. B.

22. *Direct Proofs of the Existence of the Counter-Trades.* **A. L. Rotch** and **L. Teisserenc de Bort.** (Comptes Rendus, 141. pp. 605–608, Oct. 9, 1905. Nature, 73. pp. 54–56, Nov. 16, 1905.)—Hergesell [see Abstract No. 519 (1905)] having observed winds from the NW., but never a proper winter trade in the higher atmospheric strata above the Atlantic, the authors agreed upon a common line of experiments which were conducted through July and August by Clayton and Maurice from the Azores, Madeira, Teneriffe, and the Cape Verde Islands. On land the wind generally drops at a certain height, above which kites cannot be raised; there is also difficulty when kites are flown from steamers, because the upper and the lower kites are exposed to different winds. Ballons sondes were therefore employed, and sent up to 13,600 m. maximum. The conclusions are the following: In the lower strata the winds blow from NE. and E., in the higher—above 1,000 m. as a rule—from NW. to NE. To the north of Madeira and the Azores the upper winds are from W. and NW., as was known from cloud observations; these districts are north of the ordinary barometric maximum and outside the trade-winds area. The counter-trades blow from the S., as a rule from SW. near the Canaries, and from SE. near Cape Verde. This is to prove the existence of the traditional counter-trades. H. B.

23. *Meteorological Observations during the Solar Eclipse of August* 30, 1905. **H. de la Vaulx** and **J. Jaubert.** (Comptes Rendus, 141. pp. 512–513, Sept. 11, 1905.)—A complete series of observations was made at the Military Hospital, Constantine, Algiers, in a balloon, and by a ballon sonde. The barometer fell by a few tenths of a mm. during the eclipse; the air temperature was high throughout, about 35° C., and fell by 5° C. on land and by 3 or 4° in the higher strata; the humidity rose from 0·18 to 0·32; the wind veered through 270° from SE. through S., and returned immediately after the eclipse to its original direction. Reading was impossible in the balloon at 2,500 m., possible below. Peculiar striated shadows were observed on land—less well from the balloon—for 20 sec. before and after totality. **L. Libert.** (Ibid. pp. 513–514.)—On the suggestion of Bigourdan, a sheet of cloth, of 25 m.², was stretched out on a terrace in Tripoli, Berbery, and the wind direction was watched with the aid of small balloons. Alternating bands of light and darkness, displacing one another in a direction at right angles to their arrangement and frequently sinuous, were first noticed 6 min. before totality, at 2.39 p.m. The whole phenomenon recalled the effect of the sunlight, reflected by the sea-waves, when watched through a Venetian blind, on the walls of a room. H. B.

24. *Intensity and Direction of the Force of Gravity in India.* **S. G. Burrard.** (Roy. Soc., Phil. Trans. 205. pp. 289–318, Oct. 12, 1905. Roy. Soc., Proc. Ser. A. 76. pp. 313–315, July 10, 1905. Abstract.)—Between 1865 and 1873, Basevi and Heaviside took pendulum observations at 31 stations in India with the Roy. Soc. seconds pendulum. Afterwards the deflection of the plumb-line was observed all over the country. In 1901 the necessity for determining the intensity of gravity in addition to the direction of gravity was recognised, and pendulum observations were resumed with a Sterneck apparatus. In his celebrated classification of the pendulum observations, taken all over the world, Helmert in 1900 pointed out that Basevi had had no means of measuring the flexure of his pendulum stand; that would affect his results, notably the determinations made at Moré—the highest station in Asia—on which Airy and Pratt had based theories of mountain compensation. Lenox Conyngham found, indeed, in 1904, that all Basevi's values were too small, at Dehra Dun, *e.g.*, by 4 whole vibrations in a solar day (of about 86,021 vibrations). Deflections of gravity are no longer attributed to accidental and local attractions [see Abstract No. 971 (1904)], but they can be classified in regions. On the Himalayan meridians the direction of gravity follows a general law; its direction changes from northerly to southerly near the tropic, continues southerly over the Ganges valley, and becomes northerly again. An observer in the plains of Northern India would, trusting to his eye and spirit-level, place a great mountain range to the north and low hills to the south; relying on pendulum and plumb-line, he would imagine he stood between two mountain ranges, of which the southerly was rising slowly. In the former case he would believe Dehra Dun (at the foot of the Himalayas) to lie 500 ft. above Kalianpur (Central India); in the latter case, Kalianpur would appear to lie 4,700 ft. above Dehra Dun. The resulting attraction at Kalianpur has now been redetermined, and the deflection of the plumb-line found to be 6·4″ to the south. H. B.

25. *Evolution of the Solar System.* **F. R. Moulton.** (Astrophys. Journ. 22. pp. 165–181, Oct., 1905.) [See "Fundamental Problems in Geology," T. C. Chamberlin in Year Book No. 3 of the Carnegie Inst., Washington, pp. 195–258, for fuller description.]—In all the variations of Laplace's theory it has been assumed that the original nebula, from which our system is supposed to have been formed, was in a state of temporary hydrodynamical equilibrium, maintaining its volume largely by gaseous expansion, and that the planets have developed out of rings left off from the parent mass. The author and Chamberlin have rejected the ring theory as giving inconsistent results and to replace it have formulated a new theory called the "Planetesimal Hypothesis," the main features of which are given in the present paper. *Outline of the Theory.*—It is supposed that our system has developed from a spiral nebula which originated at a time when another sun passed very near our sun. The dimensions of the nebula were maintained almost entirely by the orbital motions of the great number of small masses of which it was composed. It was never in a state of hydrodynamical equilibrium, and the loss of heat was not necessary for its development into planetary masses. The planets have been formed around primitive nuclei of considerable dimensions by the accretion of the vast amount of scattered material which was spread throughout the system. *Origin of Spiral Nebula.*—The near approach of another sun, S′, to our sun, S, raised on S a huge tide on the side toward S′, and an almost equal one on the opposite side. Our sun was then agitated by great energies such as now produce the eruptive prominences. The enormous tidal strains increased the eruptive tendencies toward and from S′, and large quantities of material were ejected with great velocities in both of these directions. If it had not been for the subsequent disturbing effects of S′ these ejected masses would have returned to the sun, but S′ drew them from their rectilinear paths and left them describing ellipses around the sun. *Revolutions of the Planets.*—The matter was originally ejected irregularly with occasional large nuclei which have grown into the planets by the accretion of the finer scattered material. The direction of ejection depended upon the direction of S′, the lag of tides on S, and the original direction and rate of rotation of S. Consequently the original directions were not all exactly in the plane of motion of S, but taking into account ejections both toward and from S′ and both before and after perihelion passage of S′, the matter was distributed nearly symmetrically with respect to the plane of the orbit of S′. It follows from the mode of generation of the orbits of the ejected material that the planets must all revolve in the same direction, and from the above that their planes will nearly coincide. The formation of the satellites and the planetoids is next dealt with. *Physical Condition of the Planets.*—The original nuclei were too small to possess sufficient gravitative power to control true atmospheres. Hence they cooled rapidly and became solid. The scattered material likewise lost its heat rapidly. Hence the planets have grown up from solid material, and have been solid nearly since the visit of S′, and their atmospheres have been acquired later from the occluded gases which escaped as they contracted.—The questions of rotation of the planets and of eccentricity of their orbits are discussed. Regarding moment of momentum of the system, it is claimed that while this is a rock on which the ring theory breaks, the facts are an inevitable consequence of the spiral theory. The paper concludes with a discussion of the retrogade revolution of the ninth satellite of Saturn. A. E.

26. *Evolution of Stellar Spectra from the Nebular Stage.* **W. E. Wilson.** (Roy. Soc., Proc. Ser. A. 76. pp. 374–380, Aug. 4, 1905.)—Premising the initial existence of a mass of gas at a sufficiently high temperature to radiate light waves into the surrounding space, if this were sufficiently rare to be transparent to all wave-lengths except those which it is itself able to radiate, its spectrum would be one of bright lines. As the mass slowly cools the central density will increase, and as this goes on the bright lines will thicken, and finally produce a continuous spectrum. Soon the gravitational forces would cause some separation of the constituent gases into layers having a probable definite relation to their atomic weights, and then the heavier elements would give a bright, banded and almost continuous spectrum in the interior of the nebula; the lighter and cooler elements, hydrogen and carbon say, would begin to show a dark-line spectrum, which would continue until the temperature reached that where carbon condenses to a liquid. When this occurred the cloud of carbon particles would give a perfectly continuous spectrum, and this would correspond to the solar photosphere as we know it, the dark lines of the Fraunhofer spectrum corresponding to the absorptions of such elements as are still existing as vapour above the carbon clouds, and also of any others which may be periodically carried through the carbon layer by solar disturbances. It is suggested that the sun's atmosphere consists principally of hydrogen and helium, with only minute traces of such substances as sodium, and that the spectrum of a star may depend far more on the partial pressures of the elements in its atmosphere than on its temperature. With regard to experiments on the interpretation of spark spectra, there seems to be little direct evidence for stating that the spark is hotter than the arc, and great caution is necessary in allotting relative temperatures

to groups of stars from the presence or absence of characteristic spark lines in their spectra. The author emphasises the following conclusions: (1) If the temperature of a star is sufficiently high to enable the gases, if dense enough, to emit all their lines up to the extreme ultra-violet, then an increase of temperature would have very little effect in altering their spectrum. (2) Differences in the partial pressure of any one gas in two stars of the *same temperature* may have a very large effect in determining the lines that would be seen in its spectrum. (3) Stars whose temperatures were slightly above and below the critical point at which the photospheric clouds are formed would differ largely in their spectrum. (4) From the above causes it would seem impossible to classify stars on a scale of temperature alone.

C. P. B.

27. *Figure of the Sun.* **C. L. Poor.** (Astrophys. Journ. 22. pp. 103-114, Sept., 1905.)—An investigation of the figure of the sun was suggested by the number of solar photographs taken by L. M. Rutherford in his private observatory and afterwards presented to the Observatory of Columbia University. It had previously been found by Jacoby that star plates taken by Rutherford had suffered no deterioration, and were capable of giving results comparable with the best heliometer measures. Out of 139 plates, 22 were selected for measurement, 4 of which were taken in 1870, 8 in the spring and summer of 1871, and 10 in 1872. Measures were all made in duplicate on the Repsold measuring machine, 28 points being determined round the sun's limb in terms of polar co-ordinates. After correction these gave mean values of the polar and equatorial radii of each disc of the sun measured. The differences between these values were tabulated in order of date, when it was at once seen that there was good agreement between the values for any one year, but the mean results for different years differed radically. Thus the plates of 1871 show the equatorial radius to exceed the polar by some 0″·3; while the plates of 1870 and 1872, on the other hand, show the polar radius to be the greater by some 0″·2 As the plates were all taken with the same instrument and under the same conditions, and in similar seasons of the year, it would appear that the changes thus indicated are due to real pulsations in the figure of the sun's disc, and therefore from this series we may conclude that during the period 1870–72 the equatorial diam. was first increasing, and then shrinking relatively to the polar diam. It was then decided to examine Auwer's reductions of the heliometer measures made in connection with transits of Venus in 1874 and 1882, as it was found that while adjusting and determining the constants of the instruments the German observers had made a great number of accurate determinations of the sun's diam. These were rearranged solely in order of date, and it was at once apparent that again a progressive change had been recorded, and it is in general agreement with that previously determined from the Rutherford photographs. During 1873–75 the equatorial diam. was first slightly the greater, while at the end of the period the polar diam. was decidedly the larger. During 1880–83 the equatorial diam., although actually the smaller, was continually increasing with respect to the polar diam. The change for the period 1880–83 is thus seen to be the reverse of that found for the former period of 1874–5, at which time the equatorial diam. was relatively shortening. Five solar photographs taken at Northfield by H. C. Wilson have also been measured, giving data for 1893–4, and these indicate a relative shrinking of the equatorial diam. It was at once found on plotting these results in comparison with the sun-spot frequency curve that there was a general

agreement. The obvious conclusion is that the ratio between the polar and equatorial radii of the sun is variable, with a period identical with the sun-spot period. The equatorial is usually the greater diam., but at intervals the polar becomes equal to it or greater, the sun passing from an oblate to a prolate spheroid. In this variable figure of the sun may be the explanation of the anomalies in the motions of Mercury, Venus, and Mars.
C. P. B.

28. *Water Vapour in the Martian Atmosphere.* **Lowell, Slipher.** (Nature, 72. p. 465, Sept. 7, 1905. From Lowell Observatory, Bull. No. 17.)—The author first describes a new spectroscopic method of determining the existence of water vapour in the atmosphere of a planet, depending chiefly on the displacement of lines from a body in motion. The earth's atmosphere is spectroscopically at rest with regard to a terrestrial observer, whilst the Martian atmosphere partakes of the planet's motion relative to the earth. This relative motion will be reflected in the solar spectrum obtained on a spectrogram of Mars, by a displacement of those lines which are due to the selective absorption common to both atmospheres. We know that in the terrestrial atmosphere water vapour accounts for a great deal of this absorption, so that if water vapour also exists in the atmosphere of Mars its lines should show a displacement, or possibly only a broadening of such lines as those in the *a* band of the solar spectrum. For comparison the spectrum of the moon is photographed. In the same paper Slipher discusses the results obtained from a practical trial of the above method. Several spectrograms were obtained of the moon and Mars, the exposures being made when these objects were at the same altitude. An examination of the *a* band and the water-vapour lines near D indicated a slight displacement, but the measurement was uncertain. Similar experiments on the spectrum of Venus were equally inconclusive. C. P. B.

29. *Interpretation of Spectroheliograph Pictures.* **M. N. Donitch.** (Nature, 72. p. 495, Sept. 14, 1905. From No. 4044 of Astron. Nachr.)—Commenting on the views of G. E. Hale [see Abstract No. 1866 (1905)], the author points out that in spectrograms of the chromosphere taken during total eclipses of the sun, the lower layers of the eruptions, *i.e.*, those nearer to the moon's limb, appear to be the most extensive, while in the Yerkes photographs the opposite appears to be the case. It is thought that these apparently divergent views may be reconciled by slight modifications of the theory as to how they correspond with the different regions of the H line of calcium in which the spectroheliograms are photographed. [See Abstract No. 471 (1904).]
C. P. B.

30. *Lunar Theory from Observation.* **P. H. Cowell.** (Nature, 73. pp. 80–81, Nov. 23, 1905).—The author has been engaged for some time past in investigating the various lunar inequalities, and has succeeded in getting definite confirmation of many previously doubtful terms, the application of which will greatly improve future places. The moon's longitude contains over 150, and the latitude about 100, inequalities over $0''\cdot 1$. The arguments of these inequalities, and the mean longitude of the moon, require a knowledge of three angles connected with the moon, viz., the moon's mean longitude, the mean longitude of perigee, and the mean longitude of the node. The problem in view, therefore, has been to determine the values of

three angles as functions of the time, and to give a list of some 250 inequalities as accurately as possible. By a special method of reduction, he has succeeded in obtaining practically the same value of the eccentricity of the moon's orbit from two different series of observations compared with two different systems of tabular places. Another term previously incorrectly estimated is shown to have a probable period of 350 years. Dealing with ancient solar eclipses, they are shown to give an accurate measure of the relative distances of the node, the sun, and the moon. The position of the node may be inferred with certainty from the gravitational calculations of Brown, whose theory may now be confidently taken as the final and correct solution of the problem of three bodies. Thus the author's eclipse results determine the position of the sun as well as of the moon, and the surprising conclusion is reached that *the sun's motion is being accelerated.* The most obvious hypothesis to account for this observed fact is that the ether has a sensible retarding effect. It may seem curious that the resistance of the ether should accelerate the earth's orbital motion, but that undoubtedly would be the effect. The total energy must be diminished, and this implies that the planet falls in towards the sun, and consequently revolves faster in its orbit. C. P. B.

31. *Observations of the Solar Eclipse, August 30, 1905, made at Robertville, Algiers.* **Salet.** (Comptes Rendus, 141. pp. 528–530, Sept. 25, 1905.)—The following is a list of the chief results sought and obtained by the author's expedition : (1) *Search for the existence of a magnetic field in the neighbourhood of the sun, by observation of the deviation of the plane of polarisation of the coronal light.*—For reasons of symmetry this plane should be radial if there is no magnetic action in the corona. It was found to be deviated in the right-handed sense by 2°·5. This deviation had never been measured before. Its smallness seems to indicate that the sun, in spite of its mass, has a magnetic field of inconsiderable extent. The measures were made with an equatorial of 9·5 cm. aperture furnished with a reticule and a Savart's polariscope placed before the eyepiece. The bands due to atmospheric polarisation were suppressed before the observation by turning the eyepiece about its axis. (2) *Photographic Study of the Distribution of the Polarised Light of the Corona.*—A photographic attachment was added after making the visual observations, and 15 strongly marked polarisation bands were obtained, decreasing regularly in intensity. They are visible to about 1½ diams. from the sun's limb, that is, to the edge of the outer corona. The polarisation is maximum at 5° or 6° from the sun. It extends into the inner corona, diminishing in intensity, up to the very edge of the moon. The plane of polarisation is everywhere nearly radial. The slight deviation which was measured visually can be verified on the plates. The fact of a prominence being found "*à cheval*" across two of the bands furnishes a proof of the non-polarisation of the prominences. None of the plates show any trace of atmospheric polarisation outside the corona or on the moon. (3) *Atmospheric Polarisation.*—The registering apparatus was pointed at regions 90° from the sun, too far to give results. At 30° or 40° from the sun bands remained visible during totality. Near the sun the direction of the plane of polarisation was vertical. (4) *Spectropolarisation of the Corona.*—A method was tried for determining whether the lines in the coronal spectrum were of coronal, chromospheric, or atmospheric origin, by examining their polarisation. Now the reflected light from the corona is polarised radially, the diffuse sky-light vertically, and the proper light of the corona not at all. A nicol was accordingly placed before

half the slit of the spectroscope, and set so as to completely extinguish light polarised in the direction of the slit, *i.e.*, the light reflected from the corona, which is polarised radially. On the plate which was obtained, the continuous spectra corresponding to the two sides of the corona differ in intensity in consequence of the suppression by the nicol of the reflected sunlight. But a prominence, which was probably at the edge of the nicol, gives rise in spite of the nicol to three intense hydrogen lines with a strong halo at their base. The coronium line, which is very strong and extends to about 4′ from the sun's edge, shows on both sides, and so do the two calcium lines, the latter, however, being much stronger on the side where the prominence lies. The helium line, which is well marked, is only visible on this side, as are 8 other lines not yet measured. *Photography of the Ultra-violet Spectrum of the Corona.*—The plate obtained shows some 15 lines in the extreme violet between 338 λ and 305 λ, which have not yet been fully examined. A. E.

32. *Eclipse Spectroscopy, August* 30, 1905. **M. Stefanik.** (Comptes Rendus, 141. pp. 585–586, Oct. 9, 1905.)—Observing at Alcosebre, in Spain, the author attempted to obtain spectroscopic observations of the reversing layer in the region less refrangible than C (H_α), and also to study the coronal radiations, with special reference to the green line. He used a Prasmowsky objective of 0·80 m. focus, with a Duboscq spectroscope having a single prism of carbon bisulphide. Light from the sun was reflected into the instrument by the plane mirror of a Silbermann heliostat. The slit of the spectroscope was covered by a red screen to mask the other parts of the spectrum, and so avoid confusion. No bright lines were seen in the reversing layer from A to the extreme red either at commencement or end of total phases. After totality the monochromatic image of the corona in light of λ530 was very brilliant; the continuous spectrum of the corona appeared to be of maximum intensity between D and 530. **G. Millochau.** (Ibid. pp. 586–588.)—Millochau (at Alcosebre) employed three spectroscopic instruments for various researches on the spectrum of the solar surroundings. Two spectrographs were included, and these were operated at the proper instant, and determined by visual observation with a telespectroscope. All the more intense radiations of the reversing layer between C and K were obtained, and the green ray of the corona was photographed with considerable intensity. **J. Comas Solá.** (Ibid. pp. 616–617, Oct. 16, 1905.)—Observing at Vinaroz, Sola was able to secure three photographs of the corona with a 6-in. Grubb objective, with exposures varying from 8–12 sec. Streamers were obtained in the west of the sun's limb extending to about three solar diameters. The longest filaments were equatorial and rectilinear. The photographs also show the prominences well. Special rapid anti-halo Ilford plates were employed. For recording the spectrum of the solar surroundings a prismatic camera was employed, having an objective of 11 cm. aperture, with a large flint prism of 60° angle placed before it. Many differences were found in the spectra of the small and large protuberances. In almost all the small prominences the ray H of calcium appears to be absent. In one which does show H the rays H_δ and H_γ of hydrogen are invisible, and in others the green blue line H_β or F of hydrogen is not seen. Five minutes before totality the ray H_γ was found reversed, but H and K were not reversed until almost the commencement of the total phases. The solar surroundings were in general much brighter than in 1900, and the form of the corona is in agreement with that expected at such epochs of the solar activity. C. P. B.

33. *Total Solar Eclipse, August* 30, 1905. **G. Millochau.** (Comptes Rendus, 141. pp. 815–818, Nov. 20, 1905.)—Observing with a telespectrograph the photographs showed many details of the various phases of the eclipse. At second contact a negative was taken with 4 sec. exposure, showing the coronal and higher chromospheric spectrum. Another was started at 40 sec. after second contact, and given 110 sec. exposure. This shows the spectrum of three brilliant prominences and the spectrum of the corona. In the prominence spectra the chief constituents are hydrogen and helium, and from there being no trace of photographic impression in the parts symmetrical with the prominences, it appears that the corona does not contain H or He. All the brighter regions of the corona as seen were shown strongly in the green image. At the third contact a photograph of the reversing layer spectrum was secured, all the crescents having apparently the same height, corresponding to a concentric ring round the sun of about 0·7 in. in depth. Measures on the chromosphere gave a height of about 8″ or 4″. Subsequent photographs of the spectrum of the diffuse sky light gave the result that the intensity of the continuous spectrum of the corona was about equal to that of diffused sky light at 90° from the sun, exposed for 20 sec. with same instrument and plates. C. P. B.

34. *Spectroscopic Determination of Solar Parallax.* **F. Küstner.** (Nature, 72. p. 611, Oct. 19, 1905. From Nos. 4048–9 of Astron. Nachr.)—The author describes in detail the method he has devised for determining the solar parallax spectroscopically. He measures 16 lines on each of a series of spectrograms of the star Arcturus, obtained during the period 1904, June 24–1905, Jan. 15, with the spectrograph at the Bonn Observatory. This resulted in a mean value of the radial velocity of Arcturus of $-4·83 \pm 0·27$ km. for the epoch 1904, and the mean velocity of the earth $29·617 \pm 0·057$ km., the accepted value for the velocity of light *in vacuo* being $299,865 \pm 26$ km. per sec. The previously accepted parallax, 8·500″, is equivalent to 29·765 km. for the earth's velocity, and by proportion therefore a new value of the parallax may be computed from a new observation of the earth's velocity. In this way the author suggests the value of the solar parallax to be $8·844 \pm 0·017''$. C. P. B.

REFERENCES.

35. *Apparatus for Artificial Eclipses of the Sun.* **C. André.** (Comptes Rendus, 141. pp. 168–170, July 17, 1905.)—A small occulting disc is fitted in a slide near the eyepiece collar of an astronomical telescope, driven by clockwork, so that observations may be made of the solar disc when occulted to various degrees by the artificial screen. The practice thus obtained facilitates the taking of measures of the varying geometrical figures presented during a real solar eclipse. Imitations of partial or total eclipses are regulated by adjustment of the occulting disc. C. P. B.

36. *Perpetual Motion Machines.* **F. Charlesworth.** (Cassier, 29. pp. 115–125, Dec., 1905.)—Deals with the different principles employed in various patented machines and gives illustrations of several typical forms.

37. *Theory of Sundials.* **L. Weinek.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 831–841, June, 1905.)—The mathematical theory of different types—equatorial, horizontal, vertical—is worked out. J. W. P.

38. *Planimeter for Determining Mean Ordinates.* **A. Schmidt.** (Zeitschr. Instrumentenk. 25. pp. 261–273, Sept., 1905.)—A lengthy description of the instrument (which is rather complicated in construction) is given. The method of use is described, and results given to show the high degree of accuracy obtained with the instrument. A. W.

39. *Modified Electric Control for Driving Clocks.* **H. Grubb.** (Roy. Dublin Soc., Proc. 11. 4. pp. 34–36, and 5. pp. 37–38, Sept., 1905.)—The well-known control of the author, used for the instruments of the International Photographic Survey of the Heavens, has been considerably simplified, chiefly by reducing the number of contacts in the commutator of the magnetic regulator. A diagram is given of the new form. In the second paper a new right-ascension slow motion is described. C. P. B.

40. *Rotation of an Axis under Action of Couple.* **V. Knorre.** (Zeitschr. Instrumentenk. 25. pp. 242–247, Aug., 1905.)—An analysis of the forces and strains involved in the rotation of an axis under action of a couple—a condition which frequently occurs in astronomical mechanism. C. P. B.

41. *Range of Adjustment for the Conical Pendulum.* **F. Slate.** (Phys. Rev. 21. pp. 166–168, Sept., 1905.)

42. *Experimental Method of Determining Complicated Stress-distributions.* **Wieghardt.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 1568–1569, with Discussion, Sept. 23, 1905. Paper read before the Aachener Bezirksverein, May 3, 1905.)—In many cases the differential equations arrived at in dealing with elastic bodies are very difficult to integrate. The differential equations for one or two equilibrium-systems of forces acting on elastic bodies are given, and also a method of solution for the case of a thin elastic plate of a certain shape. A. W.

43. *Shearing Stresses.* **W. E. Lilly.** (Engineering, 80. p. 614, Nov. 10, 1905.)—A solution for the maximum shearing stresses in the bracing of girders under a uniform advancing load equal in length to the span is given. J. W. P.

44. *Effect of Motion Ahead on the Rolling of Ships.* **A. W. Johns.** (Inst. Naval Architects, Trans. 47. 1. pp. 186–196; Discussion, pp. 196–198, 1905.)—The subject is dealt with under the following sections: Frictional resistance; Head resistance; Energy lost by imperfect restitution; Energy lost by motion given to dead water; Large angles of roll; Experimental results.

45. *Effect of Acceleration on Ship Resistance.* **C. E. Stromeyer.** (Inst. Naval Architects, Trans. 47. 1. pp. 178–184; Discussion, p. 185, 1905.)

46. *Influence of Depth of Water on Speed of Vessels.* **W. W. Marriner.** (Inst. Naval Architects, Trans. 47. 2. pp. 344–349; Discussion, pp. 349–358, 1905. Engineering, 80. pp. 99–100, July 21, 1905.) **H. Yarrow.** (Ibid. pp. 339–343; Discussion, pp. 349–358.)

47. *Velocity of Water flowing down a Steep Slope.* **E. P. Hill.** (Inst. Civil Engin., Proc. 161. pp. 345–349, 1904–1905.)—The usual book-formulæ apply only if the frictional resistance prevents acceleration, so that channels are usually constructed of greater dimensions than are necessary. Assuming the hydraulic mean depth to be constant and the frictional coefficient to be independent of the velocity, the author finds an expression for the velocity, and so for the necessary breadth of channel, at any point of the slope. R. E. B.

48. *Breakage of Winding Ropes in Mines.* **J. Perry.** (Phil. Mag. 11. pp. 107–117, Jan. 1906. Paper read before the British Assoc. at Johannesburg, 1905.)—Six different problems are considered under varying conditions as to stoppage and yieldingness of rope. Mathematical solutions and arithmetical illustrations are given. J. W. P.

49. *Screw Propellers.* **R. H. Smith.** (Engineer, 100. pp. 205–206, Sept. 1, 1905.)—The dynamics of the subject is discussed, and then a suggestion for constructional improvement put forward. Guided inlet and outlet channels for the water at the propeller form the essence of the plan. This leads to jet-propulsion, which the author thinks never had a fair trial. J. W. P.

50. *Tests of Cements at the Watertown Arsenal.* **J. E. Howard.** (Eng. Record, 51. pp. 521–523, May 6, 1905. Paper read before the Assoc. of Amer. Portland Cement Manufacturers, April 12, 1905.)—Deals with rise in temperature during setting, effect of low and of high temperatures, setting under high pressure, and rigidity of constructive materials and columns, as well as other points.

L. H. W.

51. *Resistance to Water Flow in Pipes by Bends.* **C. W. L. Alexander.** (Inst. Civil Engin., Proc. 159. pp. 341–364, 1904–1905. Paper read before the Birmingham Assoc. of Students, March 10, 1904.)—An experimental investigation of the nature and magnitude of the resistance offered by bends, knees, and elbows to the flow of water through closed pipes. Equations are deduced for the loss of head at bends in the case of pipes of varnished wood, drawn brass, and cast-iron asphalted. W. W. H. G.

52. *Similitude in the Motion of Fluids.* **Jouguet.** (Comptes Rendus, 141. pp. 346–348, Aug. 7, 1905.)—From dimensional considerations the author concludes that in movements which occur with very great speed the compressibility of a fluid plays an important part, the effects of viscosity and conductivity being negligible whereas the reverse is the case if the speeds are very small. R. E. B.

53. *New Class of Periodic Solutions of the Problem of Three Bodies.* **A. Wilkens.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1071–1113, July, 1905.)—A mathematical paper.

54. *Physical Meaning of the Principle of Least Work.* **H. v. Helmholtz.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 40. pp. 863–883, Oct. 26, 1905.)—A mathematical treatment elaborated by L. Koenigsberger from the papers bequeathed by the author.

55. *Motion of a Heavy Solid.* **E. Husson.** (Comptes Rendus, 141. pp. 821–823, Nov. 20, 1905.)—An extension for particular cases as well as a new demonstration of a theorem of Poincaré relating to the dependence of the integrability of the equations of motion of a solid body upon the shape of its ellipsoid of inertia.

R. E. B.

56. *Photographs of Cutting-Tools in Action.* **J. F. Brooks.** (Inst. Mech. Engin., Proc. 2. pp. 365–367, March–May, 1905.)—Lathe tools of various cutting angles, and working on various materials (cast iron, mild steel, copper, and gun-metal), have been photographed with a magnification of about 6 diameters in such a way as to show their action—the work being stopped for the taking of the photographs. The author's results are embodied in the forty photographs of the paper. W. Ros.

57. *Liquid Motions Due to Rotation of a Solid.* **A. L. Holz.** (Ann. d. Physik, 18. 2. pp. 387–394, Nov. 7, 1905.)—Discusses the analogy between the vortex motions of a liquid due to the rotation of a solid, and the lines in a magnetic or electric field. E. H. B.

58. *Fundamental Units.* **A. Willame.** (Assoc. Ing. Él. Liége, Bull. 5. pp. 380–384, June, July, Aug., 1905.)—This is in the main a criticism of Lwowitch's paper [Abstract No. 1294 (1905)]. If there are two relations of the form $\phi_1(l, m, t, f)=0$ and $\phi_2(l, m, t, f, k)=0$ connecting the three fundamental units l, m, t, and a derived unit f, k being independent of these four units, then by arbitrarily assuming k to be of zero dimensions, and equating it to unity, we may eliminate f between the above equations, thus obtaining a relation connecting l, m and t. Lwowitch's system is based on a misconception, which consists in the fact that, having adopted length and velocity for his fundamental units, he afterwards reduces velocity to a mere numeric; hence his dimensions of units are wrong, requiring multiplication by certain powers of the velocity. A. H.

59. *Minimum Thickness of Films, and Molecular Diameter.* **J. Koenigsberger** and **W. J. Müller.** (Phys. Zeitschr. 6. pp. 849–851, Dec. 1, 1905.)—A discussion and collection of the values obtained for the above quantities by Faraday, Quincke, and many others. If the molecular volume is one-third of the total volume, and the molecules are spherical, calculation gives $0{\cdot}74\mu\mu$ as the molecular diameter. [See Abstracts Nos. 1777, 1778 (1900), and 1857 (1901).] G. E. A.

60. *On the Theories of Capillarity.* **F. Krüger.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 1. pp. 68–76, May, 1905.)—A bibliography is given.

61. *Theory of the Capillary Layer.* **G. Bakker.** (Ann. d. Physik, 17. 3. pp. 471–500, July 18, 1905.)—This paper is chiefly concerned with a criticism and discussion of the capillarity theories of Laplace, Gauss, Gibbs, and Neumann. The second portion deals with questions concerning the formula for the capillarity constant and with the tension, energy, and thickness of the capillary layer. F. G. D.

62. *Ballons Sondes and Pilot Balloons from Steamers at Sea.* **(Prince) de Monaco.** (Comptes Rendus, 141. pp. 492–493, Sept. 11, 1905.)—When ballons sondes are launched on Hergesell's plan [see Abstract No. 1696 (1905)], the steamer follows the balloon combination as far as possible so that the balloon path can be traced with the help of azimuth and altitude determinations taken on board. The actual fall is frequently invisible; but the spot can be ascertained diagrammatically by a method due to Sauerwein. In some cases the balloon combination can be replaced by a single pilot balloon. Twenty-six ascents had been made on the Mediterranean and Atlantic up to 12,000 m. H. B.

63. *Synchronous Variations in Solar and Terrestrial Phenomena.* **H. W. Clough.** (Astrophys. Journ. 22. pp. 42–75, July, 1905.)—The 36-year cycle is thoroughly discussed with regard to both solar and terrestrial phenomena. In the case of the latter, Bruckner's data have been utilised as much as possible, and tables are given showing the correspondence or otherwise of the meteorological epochs with the variations of temperature, pressure, rainfall, harvests, &c., of the chief countries of the world. Auroral periods are also compared with sun-spot periods for the 11- and 36-year waves. Other cycles of shorter period, *e.g.*, 3½ years, are also discussed, and evidence of a 300-year cycle is shown graphically. [See also Abstract No. 2463 (1904).] C. P. B.

64. *Aurora Borealis of November* 15, 1905, *and Magnetic Disturbances on November* 12 *and* 15. **T. Moureaux.** (Comptes Rendus, 141. pp. 849–850, Nov. 20, 1905.)—The aurora was seen about 9 p.m. in Northern France. At Paris the sky was overcast, but the magnetic disturbances which had set in suddenly at 3.25 p.m. (mean Paris time) on Nov. 15 attained their maximum at 9 p.m., and continued during the following day. The declination decreased, the horizontal and vertical intensities increased. There had been magnetic disturbances on Nov. 12.
H. B.

65. *Condition of Helium in the Sun.* **K. Schaum.** (Gesell. Naturw. Marburg, Sitz. Ber. pp. 43–44, May, 1904.)—Deals with the occurrence of helium in the sun, and various inferences in relation to the possible production of helium from radium. C. P. B.

66. *Temperature of the Sun.* **R. Lucas.** (Astron. Nachr. 168. pp. 57–60, 1905.)—Deals with the effective temperature of the sun, the conclusion being that it is about 5,023° C. C. P. B.

67. *Stars having Peculiar Spectra.* **E. C. Pickering.** (Astrophys. Journ. 22. pp. 87–90, July, 1905. Harvard Coll. Observatory Circ. No. 98.)—A list of 22 stars whose spectra have been found to possess peculiar features, with special notes on the more important. [See Abstracts Nos. 1605, 1606 (1904), and 1714 (1905).]
C. P. B.

68. *Light-variation of Saturn's Satellites.* **P. Guthnick.** (Nature, 72. p. 611, Oct. 19, 1905. From Astronom. Nachr. No. 4049.)—From observations at the Bothkamp Observatory, the author has determined the details of the changes in magnitude of the satellites Tethys, Dione, Rhea, and Titan. The range of brightness is, for Tethys, Dione, and Titan, about 0·75 mag.; for Rhea, about 1·0 mag.; and for Japetus, about 1·75 mag. C. P. B.

69. *Progress of Solar Research.* **H. Deslandres.** (Comptes Rendus, 141. pp. 477–483, Sept. 11, 1905.)—A short discussion on the present organisation of various methods of solar research, chiefly with the spectroheliograph, with suggestions for improvement in several directions. C. P. B.

70. *Solar Eclipse Observations, August* 30, 1905. *At Paris*, **Loewy.** (Comptes Rendus, 141. pp. 446–447, Sept. 4, 1905.) *At Burgos (Spain)*, **G. Rayet.** (Ibid. pp. 490–491, Sept. 11.) **H. Deslandres.** (Ibid. pp. 517–519, Sept. 18.) *At El-Arrouch*, **H. Andoyer.** (Ibid. pp. 519–520, Sept. 18.) *At Athens*, **D. Eginitis.** (Ibid. pp. 520–521, Sept. 18.) *At Marseilles*, **Stéphan.** (Ibid. pp. 552–555, Oct. 2.) *At Sfax (Tunis)*, **G. Bigourdan.** (Ibid. pp. 541–546, Oct. 2.) *At Alcosebre (Spain)*, **J. Janssen.** (Ibid. pp. 569–571, Oct. 9.) *At Guelma (Algeria)*, **C. Trépied.** (Ibid. pp. 531–532, Sept. 25.) **E. Stephan.** (Ibid. pp. 579–584, Oct. 9.) **Bourget** and **Montangerand.** (Ibid. pp. 614–616, Oct. 16.) *At Tortosa*, **C. André.** (Ibid. pp. 867–869, Nov. 27.) *At Tripoli*, **E. Millosevich.** (Accad. Lincei, Atti, 14. pp. 399–409, Nov. 5, 1905.)—Mostly preliminary papers giving outlines of the observation programmes and the results obtained.

71. *Distribution of Ultra-violet Light of Sun's Disc.* **K. Schwarzschild** and **W. Villiger.** (Phys. Zeitschr. 6. pp. 737–744, Nov. 1, 1905.)—Photographs of the solar disc taken with a refractor of 100 mm. free aperture and 3 m. focus were measured on a Hartmann microphotometer, the reductions giving the densities at definite distances from the centre of the disc. The resulting values are plotted as curves showing the relative absorptions for various wave-lengths. C. P. B.

LIGHT.

72. *Modified Apparatus for Colour Measurement.* **W. de W. Abney.** (Roy. Soc., Phil. Trans. 205. pp. 333–355, Nov. 17, 1905. Roy. Soc., Proc. Ser. A. 76. pp. 315–316, July 10, 1905. Abstract.)—From a modification of apparatus used by the author in 1899 [see Abstract No. 812 (1900)] some slight alteration in the sensation curves has resulted, principally in the amount of "inherent white" which exists in the spectrum colours, this white being due in part to the overlapping of the three sensations. The arrangement of the colour-patch apparatus is described, which allows a comparison of any differing mixtures of spectrum colours to be made, and also allows the addition of any desired quantity of white light to the colours formed by the aid of either of the two spectra. The mean of some series of colour equations gave 68·4 red sensation + 30·2 green sensation + 1·4 violet = 100 white, and this is adopted as the standard equation for white. The fourth sensation in the violet, postulated by Burch, is found to be non-existent. A colour-analysis table is calculated from which curves representing equal stimuli of all three sensations are constructed, and the practical use of the table when combined with the author's method of defining a colour by its wave-length, luminosity, and percentage of white light is illustrated by the measurement of emerald-green and of chrome-yellow. In applying the principles to the process of colour photography, it is pointed out that, whilst the imperfection of photographic plates necessitates ascertaining the proper exposing screens by trial, it is useless to make such trials with the spectrum. The making of a colour sensitometer suitable for this purpose is then described. G. E. A.

73. *Swasey's Depression and Range-Finder, Type "A."* (Bull. of the U.S. Ordnance Dept., No. 1875, 8°, p. 66. Zeitschr. Instrumentenk. 25. pp. 345–347, Nov., 1905. Notice by Hammer.)—This instrument, constructed by Warner and Swasey, is described by the makers as a depression position-finder and range-finder combined. Type A appears, however, to be only suitable for range-finding. The instrument belongs to the class of parallactic range-finders with the base at the instrument. The base may either be a horizontal line joining two telescopes, or a vertical line representing the height of the instrument above the water-level. In the second case the distance is measured by the angle subtended by the base at the ship, which is the depression angle of the ship as read off by the observer. The vertical base has some advantages; certain difficulties, however, have to be provided against. The surface of the water is not constant, even in non-tidal waters, and the curvature of the earth and refraction must be considered. The instrument is designed for heights from 40 to 400 ft. above sea-level. The telescope is 3½ in. in aperture, and has oculars of powers 12 and 20. The scale of distances, corresponding to the angles of depression, is marked on a spiral line 10 ft. long round a drum, reading from 1,500 to 12,000 in yards, with 10-yard intervals. Fixed reference marks must be provided at distances of 2,000, 5,000, and 9,000 yards, and at a fixed height, say 10 ft., above mean low-water. For a full description of the mounting, adjustments, &c., the reader is referred to the original article in the Bulletin, which is stated to be plentifully illustrated. A. E.

74. *Colours in Metal Glasses, in Metallic Films, and in Metallic Solutions. II.* **J. C. M. Garnett.** (Roy. Soc., Phil. Trans. 205. pp. 237–288, Oct. 11, 1905. Roy. Soc., Proc. Ser. A. 76. pp. 370–373, Aug. 4, 1905. Abstract.)—An extension of a previous paper [see Abstract No. 2528 (1904)]. The object of the present paper is to obtain information concerning ultramicroscopic structure by calculating optical properties corresponding to assumed microstructures, and by comparing the calculated properties with those observed. Calculations are made for two assumed types of microstructure: (1) amorphous—that in which the metal molecules are distributed at random; (2) granular—that in which they are arranged in spherical groups. To calculate the optical constants—relative index and absorption—for any given microstructure, it is necessary to know their values for some standard amorphous state of the metal. Now Beilby has shown that polishing a metal causes the surface layer to "flow" as a liquid, and thus the polished surface is that of the metal in the amorphous state. Hence the optical constants used in the calculations are those determined by reflection from the polished surface of the metal in its normal state. Formulæ are found for the values of n and nK (n being the index, and K the absorption coefficient), for a substance composed of molecules of metal embedded in a transparent medium. The optical properties of a medium containing a given volume proportion μ of the metal are found to vary according as the metal is in small spheres or in a state of molecular subdivision, except when $\mu = 1$. A molecularly subdivided metal should produce the same colour by transmitted light in all transparent media (supposed non-dispersive and isotropic). This colour may be called the vapour colour of the metal. But when the metal is subdivided, not molecularly but into small spheres, many to a wave-length of light, the transmitted colour depends on the index ν of the medium in which the small spheres are embedded, though this colour approaches the vapour colour as ν approaches unity. Next, formulæ are deduced which are applicable only when the volume proportion of metal is small. Tables of values of n and nK for metal glasses are given. The calculated optical properties are then compared with those observed. For this purpose the absorptions of a series of glasses coloured with gold, silver, and copper were measured for the author at the National Physical Laboratory. The results are shown by curves, with absorptions as ordinates and wave-lengths as abscissæ. The calculated and observed curves are in fair agreement. The results obtained in the case of gold bear out the earlier suggestion that the colouring agent of gold ruby glass consists primarily of minute spheres of gold, many to a wave-length of light, though some discrete molecules may also be present. If gold glass when first made in the furnace be rapidly cooled, the glass remains colourless. In order to obtain ruby glass, the molten glass must be kept in the annealing oven at a high temperature for three days. But it now appears that the gold cannot, as previously suggested, be in solution in the colourless glass when first heated in the manufacturing process, or else the glass would have the colour indicated by the vapour curve. The gold must therefore be gradually reduced during the annealing process. The fact that blue colour in a gold glass is always associated with turbidity, and with a brown appearance by reflected light, is accounted for by the coagulation of small spheres. Similar remarks apply to silver and copper glasses and colloidal solutions. The blue reflection from silver glass is also discussed. The next section deals with the colouring effects of the radiation from radium, kathode rays, &c. The colours developed by the radium emanation are approximately the same as those which would be given to the glass by the presence of the reduced metal, either molecularly divided or in small spheres (nascent crystals); Villard's discovery that the kathode rays exert a reducing action supports this view. Further evidence makes it appear possible that all glasses contain free ions—as was suggested to the author by Ramsay—of metal, and that it is by the discharge of these ions, and consequent reduction of the metal, that kathode and Becquerel rays are able to produce colouration. The author next gives tables of optical constants of media containing large volume proportions of metals, and applies the information to the discussion of metallic films. The colour of light transmitted by a thin metallic film depends chiefly on the values of nK/λ for different values of λ, but is also affected by another, more complicated factor depending only on n and K. The thicker the film the less important is the latter factor. Other sections deal with Carey Lea's "allotropic" silver, H. Vogel's silver, and allotropic forms of metal. Evidence is given that Carey Lea's silver was not "allotropic," but consisted of normal silver in a finely divided state. In none of the cases of supposed allotropy examined has the existence of an allotropic form of metal been established.

A. E.

75. *Ultramicroscopic Investigation of the Colouring of Rock-salt.* **H. Siedentopf.** (Phys. Zeitschr. 6. pp. 855–864; Discussion, pp. 864–866, Dec. 1, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—Rock-salt occurs in nature sometimes in a blue, and, less frequently, in a violet colour. It may also be coloured artificially by additive and subtractive processes, according as alkali metal is introduced into the solid crystal or chlorine is withdrawn, leaving alkali metal behind. Particulars of the two methods of artificial colouring are given, and the ultra-microscopic experiments [see Abstract No. 1169 (1903)] are then dealt with, from which it appears that the colouring is due to deposits of ultra-microscopic, crystalline, variegated or pleochroitic particles of metallic sodium or potassium of a needle or leaf shape. A remarkable consequence is that there must exist, in the interior of the rock-salt crystal, a very large number of free faces and corners. Colouring of the crystals did not take place when Hg and Cd were tried in place of K and Na, and on analysing the rust-brown colours of commonest occurrence among the particles, the spectrum is continuous from 500 to 680 $\mu\mu$, there being no sharp absorption at the D line. Pseudo-pleochroism is observed in pieces which have been intensely coloured by the sodium vapour.

G. E. A.

76. *Definition of the Efficiency of a Source of Light.* **K. Schaum.** (Zeitschr. Wiss. Phot. 2. pp. 389–399, 1904.)—The author proposes the introduction of a series of definitions of units expressed by means of the following symbols: $I =$ mean spherical light intensity in Hefner units; $\Sigma =$ mean spherical total radiation; $A =$ mean spherical visible radiation; $L =$ total visible radiation; $Q =$ total energy spent; then the useful effect $= L/Q$, the light effect $= A/\Sigma$, the economy $= Q/I$, and the efficiency $= L_n/I_n : Q/I$, the magnitudes with suffixes relating to a standard light source. Instead of calculating the efficiency by means of the purely accidental value of the Hefner lamp, it would be better, according to the author, to use the "minimum light equivalent," viz., the minimum amount of energy which, with the most favourable distribution in the visible spectrum, could give a radiation intensity equal to 1 Hefner unit. The numerical basis required for the establishment of the new unit is, however, still too uncertain.

G. E. A.

77. *Position of Optic Axes of Liquids under Strain.* **C. Zakrzewski** and **C. Kraft.** (Acad. Sci. Cracovie, Bull. 7. pp. 506–520, July, 1905.)—The apparatus used before is modified to determine the above relation for different temperatures. From an examination of collodion, gelatine, and gum arabic in aqueous solution, copal varnish, and other liquids, it is concluded that these substances can be divided into two classes; the first class contains those liquids in which the axes form an angle of 45° with the ray of light for all the velocities employed and for any temperature. The second class, for which the angle is different to 45°, is formed solely of colloidal solutions, and opalescent liquids which polarise light similarly to colloids. [See also Abstracts Nos. 1387 (1904) and 1228 (1905).] G. E. A.

78. *Refractivity of Mixtures of Two Liquids.* **V. F. Hess.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1231–1251, July, 1905. Phys. Inst. der k.k. Univ., Graz, July, 1905.)—The author has examined different mixtures of turpentine-benzol, turpentine-carbon disulphide, water-alcohol, water-sulphuric acid and turpentine-ether, in respect to the contraction of volume on mixing and the accompanying "contraction of refractivity," in order to test Pulfrich's result: $(N - N_v)/N = a(D - D_v)/D$, where N is the refractivity of the mixture, N_v its value if there were no change of volume, and D and D_v corresponding values of the density. Very extensive tables are given of the numerous determinations of density and refractive index at different temperatures and for various wave-lengths for the mixtures. These show that the refractivity of a mixture may be determined from that of its constituents when a has been found for one given mixture. For any other mixture of the same liquids, the refractive index $n = (n_v - ac)/(1 - ac)$, where $n = (n_1 v_1 + n_2 v_2)/(v_1 + v_2)$, and $c = (D - D_v)/D$. The following values of a, for the mixtures in the order mentioned above, may be cited, the numbers being averages for all proportions of the mixtures at 15° C. and for the D line except in two cases: 1·364, 1·190, 0·977 for F line, 1·080, 0·566 for the F line. The effect of temperature-rise causes the value of a to recede from unity, but the change of a with temperature may be neglected if the temperature-change is not more than 10° C. G. E. A.

79. *Penetration during Total Reflection.* **E. E. Hall.** (Phys. Rev. 21. pp. 346–349, Nov., 1905.)—From expressions given in a previous paper [see Abstract No. 298 (1903)], it is concluded that the penetration during total reflection, in such a system as flint glass or crown glass, is the same whether the light passes from the denser to the rarer of the two media enclosing the film, or in the opposite direction. This conclusion is tested experimentally by means of prisms of indices 1·7597 and 1·5164. The depth of penetration is about 1–2 microns for small angles of incidence. The values obtained for opposite directions of light through the prisms differed by more than the experimental error, showing that the penetration is apparently greater when the light is incident on the crown glass. But, as the penetration is a complicated function of the intensity, and the flint-glass prism had a yellow tinge, and for other reasons, the author concludes that the penetration is independent of the order in which the light passes through the prisms.

G. E. A.

80. *Size of the Smallest Optically-active Layer of Lead Peroxide.* **J. Koenigsberger** and **W. J. Müller.** (Phys. Zeitschr. 6. pp. 847–849,

Dec. 1, 1905.)—Passive iron has, within the limits of experimental error, the same reflecting power as active iron, and it appeared that, theoretically, the surface layer causing the passivity must be thinner than λ/10 [see Abstract No. 95 (1905)]. Further experiments show that, as the thickness of a film of lead peroxide, electrolytically deposited, increases, the reflecting power is diminished, but only begins to diminish after the film attains a thickness of 0·84 $\mu\mu$. This is taken to be the molecular thickness. Further, the p.d. between the layer of oxide in lead acetate and a Pt electrode in chromic acid diminishes with the thickening of the layer, the maximum value being 1·07 volts for a thickness of 0·84 $\mu\mu$; when the thickness of the film reaches 4·20 $\mu\mu$, the p.d. becomes 0·47 volt and does not decrease as the film thickens beyond this point. The authors extend their previous statement as regards the thickness of the layer causing passivity, and now affirm that there is no such layer. G. E. A.

81. *Newton's Rings formed by Metallic Reflection.* **R. C. Maclaurin.** (Roy. Soc., Proc. Ser. A. 76. pp. 515–544, Dec. 6, 1905.)—An investigation, chiefly mathematical, of a phenomenon described by Stokes in 1876 (B.A. Report). When Newton's rings are formed between a lens and a plate of metal, and are viewed by light polarised perpendicularly to the plane of incidence, as the angle of incidence is increased the rings, at first dark-centred, disappear on passing the polarising angle of the glass, and then reappear white-centred, in which state they remain up to the point of disappearance. Stokes was inclined to ascribe the effect to the influence of a layer of gradual transition or whatever cause produced similar effects with diamond. To follow the rings beyond the limit of total internal reflection, a prism is employed with a slightly convex base, and two cases are distinguished, first when the angle of incidence is less than the critical angle of the glass, and second when it is greater, and in each case vibrations parallel and perpendicular to the plane of incidence have to be dealt with separately. From the calculations, numerous curves are drawn showing for glass, steel, and silver, the change of intensity along the radii of the rings for various angles of incidence below and above the critical angle. The result of the research is that all the remarkable phenomena of Newton's rings formed by metallic reflection are in accordance with the known principles of metallic reflection without requiring the introduction of effects of gradual transition between the media. [See also Abstract No. 1230 (1905).] G. E. A.

82. *Appearance of Stars.* **W. Holtz.** (Gessell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 238–239, 1905.)—An attempt to account for the familiar rayed or starlike appearance of the stars when seen by the naked eye. The author finds that all stars show precisely the same rays, but that in the case of the brighter stars the rays are plainer and somewhat longer. It is further remarked that the rays seen by the left and right eyes differ, and that if the head be turned the rays are rotated in a corresponding manner. It is thus concluded that the source of the rays is not in the stars but in the eye itself, the middle of the retina being not perfectly homogeneous in its sensitiveness. E. H. B.

83. *Bands in Anomalous Dispersion and Achromatic Systems.* **D. B. Brace.** (Phys. Rev. 21. pp. 289–313, Nov., 1905.)—If two systems of interfering rays, after undergoing different phase-changes, in whatever way, are

examined spectrally, dark bands are found for those frequencies where destructive interference occurs. If two sets be examined in juxtaposition, they may be made to coincide, either throughout the entire range of the spectrum or only over certain portions. The former indicates perfect, the latter partial, differential achromatism. In general, the first is unrealisable; but the latter may be attained to a greater or less extent, particularly in the visible spectrum, by means of certain elements which constitute, in special combinations, achromatic systems. The paper then treats mathematically the application of spectral bands in anomalous dispersion and in various types of achromatic systems. [See also Abstracts Nos. 1685 (1901) and 1331 (1904).]
E. H. B.

84. *Nature of the Latent Image.* **J. M. Eder.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1159–1193, July, 1905. Photochem. Laborat. der k.k. graphischen Lehr- und Versuchsanstalt, Wien.)—An extensive series of experiments on silver bromide-collodium emulsion, particularly to demonstrate differences in the reaction of the latent image, formed by various exposures, to nitric acid. The chief physical importance of the paper lies in its application of photometric methods. The quantity of light acting on an exposed plate is measured in S.M.H. units, *i.e.*, by comparison with the illumination given by a Hefner standard lamp at 1 m. during 1 sec., and the "appearance value" (Schwellenwert) or minimum exposure in S.M.H. units, which renders the image visible on development, is employed as a unit of sensitiveness. The intensity of the Auer burner used as source of light was determined by means of a Chapman-Jones photometer. The following table shows the amount of light required to bring out the successive appearances on the not very sensitive plates used, which were exposed wet and developed with glyzin-potash :—

	Exposure in S.M.H.
"Appearance value"	160
Strong half-tone of normal negative	2,400
Direct photographic blackening begins	16,000–80,000
Solarisation begins at boundary of neutral zone ...	16,000–80,000
Very strong solarisation	320,000–480,000 and over.

The results of the various experiments go to support the subhaloid theory, the view of the author being that AgBr, even when feebly illuminated, loses a small quantity (y) of Br, so that several species of sub-bromide Ag_xBr_{x-y} of unknown atomic composition are formed. This is brought out, *e.g.*, by the decrease in solubility of the latent image in nitric acid with increase of exposure.
G. E. A.

85. *Repetition of Fizeau's Experiment as to Change on Rotation of Refracted Ray by Earth's Motion.* **D. B. Brace.** (Phil. Mag. 10. pp. 591–599, Nov., 1905.) —The experiment here described was undertaken for the purpose of re-examining the results which Fizeau announced he had obtained, nearly fifty years ago, in observing a change in the azimuth of a plane-polarised ray when refracted through a plate of glass, respectively with and against the earth's motion through space. The results of the present author's observations, made under similar conditions, show that the effects which Fizeau obtained must have been due to other causes than those whose effects he supposed he

was examining, and lead to the following conclusion: The azimuth of a polarised ray, along the line of drift, is not affected by the motion of the earth through space, at least to the first order of small quantities. E. H. B.

86. *Action of a Prism on White Light.* **J. S. Ames.** (Astrophys. Journ. 22. pp. 76–83, July, 1905.)—It is generally recognised that so-called white light is not due to the superposition of regular trains of waves, but to irregular disturbances or pulses. When it has suffered dispersion by a grating or prism, however, such light may be resolved into components which have a certain periodicity impressed upon them. An attempt is made in the present paper to show analytically the action of the prism in originating these periodic trains, starting with the simplest type which can be treated mathematically, which is a so-called "jump" consisting of two homogeneous trains of waves, of the same amplitude, but different velocity, and of slightly different wave-length. [See also Abstract No. 746 (1904).] **Rayleigh.** (Phil. Mag. 10. pp. 401–407, Oct., 1905.)—Rayleigh discusses the action of a prism on light passing through it, giving mathematical interpretation to the impressed periodicities. The waves produced are of such a nature that the phenomenon may be closely illustrated by considering the minute waves produced in a mass of water by a very small obstacle moving with low velocity through the liquid. **J. Larmor.** (Ibid. pp. 574–584, Nov., 1905.)—Larmor concludes that Rayleigh's application of the phenomena of a *maintained moving source* gives an adequate picture of the *modus operandi* of the dispersion of an incident aperiodic disturbance into regular wave-trains by refraction, for all types of disturbance that are slow compared with the period of natural molecular relaxation of the refracting medium—provided, however, anomalous dispersion, which cannot be included unless a *quasi*-fractional term is *assumed* in the analysis, plays a part which is unimportant. But it is still held to be unlikely that æthereal pulses of the type of the Röntgen rays come as a rule within this limit. If this be so, white light, such as can be regularly dispersed by a prism, cannot consist of wholly irregular æthereal disturbance; each Fourier component, comprised within, say, the infinitesimal range of wave-length between λ and $\lambda + \delta\lambda$, must have sequences of regularity in its amplitude, of duration comparable with the time of optical relaxation of the dispersing medium. C. P. B.

87. *Influence of Collisions and of Motion of Molecules in Line of Sight, upon the Constitution of a Spectrum Line.* **Rayleigh.** (Roy. Soc., Proc. Ser. A. 76. pp. 440–444, Sept. 13, 1905.)—Apart from the above and other causes of disturbance a line in the spectrum of a radiating gas would be infinitely narrow. The author in 1889 investigated the widening of a line in consequence of the motion of molecules in the line of sight, taking as a basis Maxwell's well-known law respecting the distribution of velocities among colliding molecules. In this investigation no regard was paid to the collisions, the vibrations issuing from each molecule being supposed to be maintained with complete regularity for an indefinite time. Recently the question has been considered by C. Godfrey, who obtains formulæ which are complicated and are only discussed in the case where the density of the gas is reduced without limit. According to the present author's view this should make the influence of collisions disappear, so that the results should coincide with those already referred to where the collisions were disregarded from the outset. Nevertheless, the results of the two calculations differ by 10 per cent.,

that of Godfrey giving a *narrower* spectrum line than the other. This discrepancy is here ascribed to an error respecting the way in which the various free paths are averaged. E. H. B.

88. *Selective Reflection in the Infra-red Spectrum.* **J. T. Porter.** (Astrophys. Journ. 22. pp. 229–248, Nov., 1905.)—Certain substances which transmit a large percentage of the incident radiation in the visible portion of the spectrum, reflect strongly in the infra-red. For instance, the reflection from a quartz surface at wave-length 8·5 μ is 20 or 30 times greater than in other parts of the spectrum. Consequently the spectrum of rays after three reflections will contain practically only radiations of wave-length 8·5 μ. The author has employed this method, commonly known as the method of "Reststrahlen," in his experiments. One object of the researches was to throw light on the question whether the positions of reflection maxima and absorption maxima coincide, as is generally assumed. The data, however, are as yet too limited for forming conclusions. The radiometer, spectrometer, and grating used in the experiments are described, and curves are given for the sensibility of the radiometer, and distribution of energy in grating spectra of a Nernst glower; also curves illustrating the final results. The following summary shows the wave-lengths of the "Reststrahlen" from various substances, below 11 μ, determined from measurements on first-order spectra :—

Substance.	Wave-lengths.	Substance.	Wave-lengths.
Quartz	8·28 μ	Ammonium chloride	8·44 μ
Marble (white)	6·77 μ	Potassium sulphate	8·42 μ
Potassium dichromate	10·31 μ	Potassium bisulphite	8·21 μ
Copper sulphate	2·80 μ	Potassium ferrocyanide	4·84 μ
Tartaric acid	5·72 μ		

A. E.

89. *The Variability of Wave-length in the Lines of Spark Spectra.* **N. A. Kent.** (Astrophys. Journ. 22. pp. 182–198, Oct., 1905.)—The author has investigated the change in the wave-lengths of the lines of certain metallic spectra in passing from the arc to the spark. The greatest possible care was taken to guard against false shifts due to movements of the apparatus. A 21-ft. focus grating was used, and the apparatus employed is described in the paper. The results obtained may be briefly summarised as follows: When self-induction and ohmic resistance are absent and large capacity or a long secondary gap is used, the part of the spark near the terminals gives a spectrum whose lines have a greater wave-length than those in the arc spectrum. The shift in the case of titanium was of the order of 0·02 A.U. The author attributes the shift to the increased pressure due to the explosive character of the spark. These results are very important in connection with the determination of the velocity of stellar motions. E. C. C. B.

90. *Variation of Arc Spectra with Phase of the Current producing them.* **H. Crew** and **B. J. Spence.** (Astrophys. Journ. 22. pp. 199–208, Oct., 1905. Paper read before the Amer. Phys. Soc., April 21, 1905.)—The authors have investigated the spectrum of the arc, using an alternating current and an occulting screen. They have been able to photograph the spectra of the arc at certain phases of the current. The results with the carbon, Al, Mg, and Fe arcs are given in the paper; the types of changes observed may be

instanced by those of carbon, where it was found that as the phase varied from maximum to zero the carbon bands diminished in intensity until they disappeared entirely. The authors define the maximum and zero phases as those at which the characteristic radiation of the arc is at a maximum or minimum respectively. E. C. C. B.

91. *Emission Spectrum of the Welsbach Mantle.* **H. Rubens.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 346–349, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 790–792; Discussion, p. 792, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—The measurements were made with a mirror spectrometer and a fluorite or sylvin prism, and with a linear thermopile. The emission spectrum was determined in the case of a Welsbach burner with a Degea mantle (99·2 per cent. thorium oxide and 0·8 per cent. cerium oxide), the same burner without the mantle, and, lastly, the same burner with a mantle coated with iron oxide. The results are given upon curves from which it can be seen that the spectra of the Bunsen flame and of the same flame with the plain mantle are very similar in the region of long wave-lengths. This shows that the mantle has a very small emission power of its own and that also it is transparent to the radiations of the flame. In the case of the iron oxide mantle the temperature was found to be 1,050–1,100° C.; its emission was about twice as great as that of the ordinary mantle between 2 and 5 μ. Furthermore, it is not transparent to the water vapour and CO_2 emission maxima. The temperature of the ordinary mantle was found (optically) to be about 1,800° abs. The author gives a table showing the relative emission powers of the mantle and the absolutely black body at 1,800° abs.

[There is little doubt that the illumination of the mantle is due to a phosphorescent effect. If this is so, measurements of the temperature by optical means must be quite useless and will invalidate any comparison between the emission spectra of the mantle and the absolutely black body.] E. C. C. B.

92. *Velocity of Röntgen Rays.* **E. Marx.** (Phys. Zeitschr. 6. pp. 768–777; Discussion, pp. 777–778, Nov. 9, 1905. Deutsch. Phys. Gesell., Verh. 7. 21. pp. 302–321, Oct. 30, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—Hertzian waves are brought to the terminals of a very small Röntgen tube along two wires from a Lecher apparatus. The Röntgen rays so caused fall on an insulated electrode in a highly exhausted tube, and opposite this electrode is a Faraday cylinder. If the insulated electrode is charged negatively when the rays impinge on it, an emission of kathode rays results, causing the cylinder to charge up, as shown by an electrometer. Leading from the kathode of the small Röntgen tube is a wire which is joined to the insulated electrode of the second tube. This wire is adjusted in length so that the electrometer gives no deflection. A shifting of the Röntgen tube or a lengthening of the wire causes the cylinder to charge up, but if the distance between the tubes and the length of the connecting wire are increased by the same amount, a null position is again attained. The time taken by the rays to travel over the increased distance in air is therefore equal to that taken by the Hertzian waves to travel the same distance over a wire, *i.e.*, their velocities are equal. The accuracy obtained is within 5 per cent. (Phys. Zeitschr, 6. pp. 834–835, Dec. 1.)—A modification of the above apparatus, to enable the results to be demonstrated to a large audience, is described. The two plates in a Braun tube, usually employed to produce the electrostatic field, are placed so that the field of one is perpendicular to the other.

One is joined to the insulated electrode which is exposed to he rays, the other to the kathode of the Röntgen-ray tube. The spot of light on the screen therefore describes different paths according to the phases of the charges on the plates, and a given figure can be reproduced by shifting back the Röntgen tube or lengthening the wire along which the waves travel from its kathode to the insulated electrode. R. S. W.

93. *Chemi-luminescence.* **M. Trautz.** (Zeitschr. Phys. Chem. 53. pp. 1-111, Aug. 29, 1905.)—This is an exhaustive paper, the contents of which are briefly as follow. A definition and criteria are given for the recognition and limitation of chemi-luminescence. New cases of crystallo-luminescence are described, especially that of the illumination produced by crystallisation from a fused mass. A historical and critical exposition of former work on triboluminescence is given, and it is shown that, in at least several cases, triboluminescence is not due to change of modification, hemimorphism, hemihedrism, or piezo-luminescence. It is shown that chemi-luminescence is not an occasional phenomenon, but that it comprises a large number of new and peculiar phenomena. The study of many chemical reactions demonstrates that, in many cases, increase of the velocity of reaction produces visible luminescence. The action of chemically indifferent admixtures is very slight. Crystallo-luminescence takes place without appreciable electrolytic dissociation. The action of light on phosphorescence shields of calcium sulphide is in many cases undeniable. Tests for *n*-rays gave only results such as could be obtained from heat rays. The colour of the light with reaction-luminescence is not conditioned merely by the absorption of the solutions. The spectrum is continuous with crystallo- and reaction-luminescence; the appearance of these forms of luminescence is related to the composition of the substances involved. The results confirm the author's view that the velocity of reaction and intensity of luminescence are approximately proportional. T. H. P.

94. *New Kind of very Soft Röntgen Rays.* **W. Seitz.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 265-266, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 756-758; Discussion, p. 758, Nov. 9, 1905. Paper read before the 77 Naturforscher-versamml. at Meran, Sept. 24-30, 1905.)—If one continuously impairs the vacuum in a Röntgen-ray tube, or, as it is termed, makes the tube softer, then the corresponding kathode voltage decreases, and from a certain point the intensity of the Röntgen rays decreases also; when about 30,000 volts is reached, the fluorescent screen and the photograph plate have each almost ceased to act. It is shown that this may be due to the Röntgen rays then evolved being too soft to penetrate the glass wall of the vacuum tube. Other explanations and theories are also discussed. E. H. B.

95. *Supposed Radio-activity of Hydrogen Peroxide.* **M. Padoa.** (Accad. Lincei, Atti, 14. pp. 43-44, July 2, 1905.)—The author shows that the action of H_2O_2 at a distance on a photographic plate cannot be due to any form of radiation, but is caused by the emission from the peroxide of vapours capable of diffusing unchanged through various substances. If platinum-black or manganese dioxide, which is capable of decomposing H_2O_2, is inserted between the peroxide and the photographic plate, no action takes place. T. H. P.

96. *Radio-tellurium and Polonium.* **W. Marckwald.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 2. pp. 133–136, July, 1905.)—Experimental results do not confirm Debierne's view [see Abstract No. 2563 (1904)] that radio-tellurium and polonium are identical, for the decay curves of specimens of polonium indicate the presence of several radio-active constituents. The rate of decay of radio-tellurium obtained from independent observations have, however, given the same constant, so there can be no question as to its distinctive individual character. L. H. W.

97. *Radio-activity of Radio-tellurium.* **W. Marckwald, H. Greinacher,** and **K. Herrmann.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 2. pp. 136–139, July, 1905.)—The saturation current between two silver strips sealed into glass, and 2 mm. apart was measured. On one of these strips about 1/1000 mgm. of radiotellurium was deposited, and the time required to charge a condenser of known capacity to a given potential taken. As the result of experiments extending over 10 months, the law of monomolecular reactions is found to be obeyed. The radio-active constant is 0·00497 day, or $57{\cdot}4 \times 10^{-9}$ sec.; the radio-activity falls to half in 139·6 days. The average life of radiotellurium is 201·2 days. **H. Greinacher.** (Ibid. pp. 139–142.)—Greinacher gives particulars of an experiment with a strip of copper upon which radiotellurium had been deposited two years previously. The rate of decay was found to follow the same law as in the case of freshly deposited radiotellurium. With the p.d. kept constant it was found that with increasing electrode-distance the current at first increases, reaches a maximum, and then diminishes [see Abstract No. 1641 (1905)]. The curves given show that as the decay of activity proceeds further, the electrode-distance for maximum current slowly increases. L. H. W.

98. *Wave-length of Radiation given off in an Alternating Condenser Field.* **F. Sanford.** (Phys. Rev. 21. pp. 343–345, Nov., 1905.)—A continuation of work described in Abstract No. 1934 (1904), the wave-lengths found being those of radiations given off from metals, &c., when these are joined to the kathode of the secondary of an induction coil, or placed in the field of an air condenser, the plates of which are joined to an induction coil. The wave-lengths are measured by means of a plane Rowland grating and a photographic plate. The radiation is feeble, but seems to be homogeneous for nearly all the substances examined. All the wave-lengths measured lie between the limits 329 $\mu\mu$ for tin-foil, and 380–400 $\mu\mu$ for platinum. G. E. A.

99. *Definition of Radio-activity.* **F. Soddy.** (Jahrbuch d. Radioakt. u. Elektrotonik, 2. 1. pp. 1–4, May, 1905. From the English.)—To combat the view which is held in some quarters, that ozone is radio-active, and according to which "a substance which emits ions during spontaneous chemical change is radio-active," the author points out that the use of the word ion will only lead to ambiguity, and suggests that it shall not be included in any definition of radio-activity. He prefers the following: A substance may be said to be radio-active which possesses the property of emitting a *corpuscular* radiation. L. H. W.

100. *Actinium.* **S. Meyer** and **E. v. Schweidler.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1147–1158, July, 1905. From the Inst. f. theoret. Physik and the II. physikal. Inst. der k.k. Univ., Wien.)—The time for the excited activity to fall to half value is 36 min.; the different observations vary

considerably. If the wire on which the activity has been deposited is raised to a bright red heat, AcA ($\lambda = 36$ min.) volatilises, leaving AcB($\lambda = 1{\cdot}5$ min.). There is a small amount of penetrating radiation emitted, about 1·5 per cent. of the whole. The authors conclude that actinium differs from any of the products RaD, RaE, &c. R. S. W.

101. *Radio-lead.* **S. Meyer** and **E. v. Schweidler.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1195–1219, July, 1905. From the Inst. f. theoret. Physik and the II. physikal. Inst. der k.k. Univ., Wien.)—The conclusions of the authors are as follows: Radio-lead contains a substance which does not emit rays, but changes to another substance which emits β-rays, and whose activity falls to half-value in 6 to 7 days. This in turn changes to another body which gives out α-rays, and fall to half-value take 135 days. These substances they identify with the radium products RaD, D_1, and E. These products are also investigated. It is found that RaD falls to half-value in 135·5 days, that RaD_1 gives off β-rays, and that a separation of RaE and RaD [or RaD_1] can be effected by heat. R. S. W.

102. *Radio-activity of the Hot Springs of Baden-Baden.* **C. Engler.** (Zeitschr. Elektrochem. 11. pp. 714–722, with Discussion, Oct. 27, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell., Karlsruhe, June 1–4, 1905.)—The waters were examined by the method of J. J. Thomson, as used by Himstedt and by Elster and Geitel, a modified form of apparatus being used [see Abstract No. 2188 (1905)]. The nature of the radio-activity was determined by noting the rate of decay of the induced activity precipitated on a negatively charged lead wire from the emanation liberated from about 12 litres of those waters. The rate of decay corresponded closely with that of the radium emanation, but the sediment from the spring, after removing the radium salts, gave an emanation similar to that from thorium, although the latter element could not be detected; possibly the activity is due to the active constituent of thorium indicated by Hahn and Sackur. T. M. L.

103. *Luminosity of Radium Bromide.* **B. Walter** and **R. Pohl.** (Ann. d. Physik, 18. 2. pp. 406–409, Nov. 7, 1905. Phys. Staatslaborat., Hamburg, Sept., 1905.)—W. and Lady Huggins suggested that the luminosity of radium bromide was probably due to the impact of the β-rays against the nitrogen molecules of the air, and that the light might therefore originate at some distance from the salt. This conclusion, which they were not able to confirm experimentally, is shown to be correct by experiments in which a long exposure was given to photographic plates screened from the radium salt but capable of receiving light emitted 2 cm. above it. As radio-tellurium gives a similar light, the α-rays must also be active in this respect, since in this case the β-rays are absent. T. M. L.

104. *Absorption of Thorium Emanation.* **A. Klaus.** (Phys. Zeitschr. 6. pp. 820–825, Dec. 1, 1905. Phys. Inst., Freiburg, Aug., 1905.)—The author determined the absorption of thorium emanation by passing it into a Rutherford measuring vessel and shaking it up with water or petroleum for 1½ min. The absorption coefficient for petroleum was found to be 4·97, and for water 1·052 at 19° C. For radium emanation the absorption coefficient is 20 times as great in petroleum as in water. E. E. F.

REFERENCES.

105. *Ångström Pyrheliometer.* **C. Chistoni.** (Accad. Lincei, Atti, 14. pp. 451–456, April 16, 1905. N. Cimento, 10. pp. 90–98, Aug., 1905.)—The advantages of the electrically-compensated pyrheliometer of Ångström [see Abstract No. 671 (1899)] over other instruments for the same purpose are enumerated. The calibration of several makes of ammeter for use with this instrument is dealt with, and the paper closes with a table giving the constants of five instruments of the above type at temperatures ranging from —10° to 40°. Determinations of solar radiation by means of the instruments are to be given in another paper. S. G. S.

106. *Theory of Rainbow, and False White Rainbow.* **J. M. Pernter.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 785–801, June, and pp. 917–943, July, 1905.)—In the first paper the theory is given for the case of a circular source on the same lines as for a point source previously given. An examination of the conditions attending the formation of rainbows of various colours, with tables of actual observations made at various stations showing the time, temperature and mean radius of the phenomenon. In illustration the paths of reflected rays through crystals of various forms are discussed. C. P. B.

107. *Scattering of Light by Small Spheres.* **F. Ehrenhaft.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1115–1141, July, 1905. From the I. physikal. Inst. der k.k. Univ., Wien.)—On the foundation of Maxwell's equations this paper treats mathematically the problem of the incidence of light (electromagnetic waves) upon spheres small, but not infinitely so, in comparison with the wave-length. The results obtained express the intensity of the light scattered in various directions, the dependence of this upon the mean size of the particles, and in particular the state of polarisation of this scattered light. [See also Abstracts Nos. 1169 (1903) and 2589 (1904).] E. H. B.

108. *Simple Method of Demonstrating Double Refraction in a Moving Liquid.* **V. Biernacki.** (Phys. Zeitschr. 6. pp. 730–732, Nov. 1, 1905. Phys. Laborat. d. Polytech. Inst., Warschau, Feb., 1905.)

109. *Theory of Oblique Beams.* **A. Kerber.** (Zeitschr. Intrumentenk. 25. pp. 342–344, Nov., 1905.)—Formulæ are found for the sectional dimensions of an oblique beam passing through an optical system such as a plano-convex double lens, and Harting's formulæ for thin lenses are deduced. [See Abstracts Nos. 2414, 2423 (1900), and 89 (1905).] G. E. A.

110. *Apparatus to Explain Fresnel's Theory of Rotary Polarisation.* **W. Bernatsky.** (Jurn. Russk. Fisik.-Chimičesk. Obsčestva, 37. No. 7. Physical Part, pp. 207–212, 1905.)—By combining a toothed wheel simultaneously with two pairs of wheels, the author communicates to a luminous point a rectilinear harmonic movement of which the direction is vertical or turned to the right or left according to the manner in which it is connected to one or the other system of wheels. Diagrams are given. D. H. J.

111. *A Spectrophotometric Method.* **E. Hertzsprung.** (Zeitschr. Wiss. Phot. 3. 1. pp. 15–27, Feb., 1905.)—Several spectra are photographed on the same plate with logarithmically increasing exposures, and on the spectrographs obtained those parts are found which are equally black. The sensitiveness of the plate to the light corresponding to these points is inversely proportional to the product of the energy intensity in the spectrum and the exposure. [See also Abstract No. 1343 (1904).] G. E. A.

112. *Tests of Orthochromatic Plates.* **R. J. Wallace.** (Astrophys. Journ. 22. pp. 153–156, Sept., 1905.)—Comparison photographs of spectra on orthochromatic plates with various exposures, and the resulting curves of selective sensitiveness. C. P. B.

113. *Ultra-violet Absorption Spectra of the Purines.* **C. Dhéré.** (Comptes Rendus, 141. pp. 719–721, Nov. 6, 1905.)—A photographic study of the ultra-violet absorption of sarcine (mono-hydroxypurine), of xanthine (di-hydroxypurine) and of uric acid (tri-hydroxypurine) has been made. It is found that the absorption bands are displaced more and more to the less-refrangible end of the spectrum in proportion as the quantity of oxygen in the molecule increases. D. H. J.

114. *Band Spectrum of Water Vapour.* **P. Meyerheim.** (Zeitschr. Wiss. Phot. 2. pp. 131–143, 1904. Extract of Bonn Dissertation, 1904.)—The spectrum of the gas from distilled water, excited by the induction-spark without capacity, was photographed with a concave grating, and the resulting bands grouped in series. C. P. B.

115. *Structure of Third Band in Carbon Spectrum.* **J. Leinen.** (Zeitschr. Wiss. Phot. 3. 4. pp. 137–154, May, 1905. Extract of Bonn Dissertation, 1905.)—The carbon spectrum was photographed in the second order of a large concave grating, and the resulting measures of the lines in the third band discussed in the endeavour to find a covering formula. C. P. B.

116. *Arc Spectrum of Tantalum.* **H. Morsch.** (Zeitschr. Wiss. Phot. 3. 5. pp. 181–202, July, 1905. Extract of Bonn Dissertation, 1905.)—Details of the arc spectrum of tantalum from λ2500 to λ5800, obtained with a large concave grating of 6·5 m. radius. The substance used was potassium-tantalum-fluoride. C. P. B.

117. *Arc Spectrum of Samarium.* **C. Ruetten.** (Zeitschr. Wiss. Phot. 3. 5. pp. 181–202, July, 1905. Extract of Bonn Dissertation, 1905.)—The details of the arc spectrum of samarium from λ2500 to λ5800 obtained with a concave grating of 6·6 m. radius, using samarium oxalate. C. P. B.

118. *Band Spectrum of Copper in Oxyhydrogen Flame.* **W. Lanzrath.** (Beibl. Ann. d. Physik, 29. 16. pp. 813–814, 1905. Extract of Bonn Dissertation, 1904.)—Photographs of copper oxide and copper metal in the oxyhydrogen flame were reduced and bands adapted to various series formulæ. C. P. B.

119. *Structure of the Fourth Band in the Carbon Spectrum.* **O. H. Hindrichs.** (Beibl. Ann. d. Physik, 29. 16. pp. 815–816, 1905. Extract of Bonn Dissertation, 1904.)—Measures of the carbon band at λ4737, with discussion of its relation to series formulæ. C. P. B.

120. *Radiations from Quinine Sulphate.* **A. Kalähne.** (Phys. Zeitschr. 6. pp. 778–779, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905. Ann. d. Physik, 18. 3. pp. 450–472, Nov. 21, 1905. Écl. Électr. 45. p. 464, Dec. 23, 1905.)—It is found that there are no rays of the nature of the β- or γ-rays. Whether the ionisation is due to ultra-violet light or α-rays is not determined. R. S. W.

121. *Simple Method of Measuring Emanation in a Liquid.* **H. W. Schmidt.** (Phys. Zeitschr. 6. pp. 561–566, Sept. 15, 1905. Phys. Inst. d. Univ., Giessen, July 8, 1905.) R. S. W.

HEAT.

122. *Determination of Heat Conductivity.* **J. Thovert.** (Comptes Rendus, 141. pp. 717–719, Nov. 6, 1905.)—Assuming an experimental arrangement in which the heat is propagated in a direction towards the interior of a mass of prismatic or cylindrical form, and adopting the ordinary unit of heat, the diffusion of the heat may be expressed by the equation—

$$(1)\ d\theta/dt = \mathrm{D}\,.\,d^2\theta/dx^2,$$

if the loss of heat by radiation and external conduction is neglected. The constant D, which represents the rate of diffusion of the heat, is connected with the calorific conductivity k by the relation $k = \mathrm{D}c\rho$, where ρ designates the specific mass and c the specific heat of the substance at the temperature of the experiment. For different experimental conditions one may give the solution of equation (1) in the form—

$$(2)\ \theta = \mathrm{A} + \sum_{n=1}^{n=\infty} \mathrm{B}_n \cos \frac{n\pi x}{h}\, e^{-\frac{n^2\pi^2}{h^2}\mathrm{D}t}$$

where h is the length of the prismatic fragment contained between two sections across which the flow is zero or a maximum. The series of equation (2) can, after a certain interval of time, be reduced to its first term, and hence, after a certain moment, the temperature θ at any point whatever will vary as the exponential $e^{-\frac{n^2\pi^2}{h^2}\mathrm{D}t}$. If we take Napierian logarithms of the successive temperature values (or of any other quantity proportional to them, these logarithms will be a limited function of the time, and Δ, the angular coefficient of the variation, will be connected with the rate of diffusion of the heat by the relation $\mathrm{D} = (h^2/\pi^2)\Delta$. The reasoning is supported by some preliminary experiments conducted by the author. D. H. J.

123. *Expansibility of Hydrogen.* **A. W. Witkowski.** (Acad. Sci. Cracovie, Bull. 6. pp. 305–338, June, 1905.)—The method employed was that formerly used for air, two receivers of known volumes, the one at 0° C. and the other at a variable temperature, being simultaneously charged with the gas under the same pressure, and these masses of gas being measured by discharge into suitable volumenometers. The particular temperatures 100°, 20°, −77°, −104°, −147°, −183°, −190°, −205°, −212° C. were employed, and pressures up to 60 atmospheres. Isothermals were determined for the temperatures down to −147°, but for lower temperatures it was found more advantageous to determine the isopiestics, the pressures taken being 10, 20, 30, 40, 50, 60 atmos. Down to −104° within the experimental range of pressure the mean isopiestic expansibility between 0° and θ° diminishes as the pressure increases, at −147° it increases with the pressure up to 30 atmos. and diminishes as the pressure further increases, for −183° and lower temperatures it continuously increases with the pressure; the smallest value found was 0·003558 at 100° and 60 atmos., and the largest 0·003841 at −212° and 60 atmos. For −183° and lower temperatures minimum values of pv were found to exist, viz., at about 32, 43·5, 55, 54·8 atmos. respectively for

−183°, −190°, −205°, −212°. The sum of the experiments gives the characteristic—

$$pv = (a + b/v + c/v^2)[1 + (d + e/v)\theta] - \phi(\theta) - \chi(\theta)/v,$$

where $a = 0{\cdot}999384$, $b = 0{\cdot}0006154$, $c = 0{\cdot}000000706$, $d = 0{\cdot}0036612$, $e = 0{\cdot}000000984$; $\phi(\theta)$ and $\chi(\theta)$ being functions of the temperature which are insensible at temperatures above −100° and are otherwise of small value. R. E. B.

124. *Specific Heat of Superheated Steam.* **O. Knoblauch.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 372–374, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 801–802 Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—This is a preliminary notice of experiments made in conjunction with M. Jakob within a range of pressures up to 8 atmospheres and of temperatures up to 350° C.; these confirm Linde's theoretical and Lorenz's experimental conclusion that the isopiestic specific heat diminishes with rise of temperature but increases with rise of pressure. The values actually found differ at most by 3 per cent. from those calculated by Linde, but are in many cases considerably less than those obtained by Lorenz, especially at high pressures and low temperatures where the differences reach 20 per cent. The steam was generated on a large scale, and, after being dried, was electrically superheated, and the heat absorbed was electrically measured. A full account will shortly appear. R. E. B.

125. *Impossibility of Explosive Dilatational Waves in Gases.* **G. Zemplén.** (Comptes Rendus, 141. pp. 710–712, Nov. 6, 1905.)—The demonstrations hitherto offered of this impossibility are unsatisfactory; they are founded on the law of energy, with which, however, the propagation of such waves as those in question are not in contradiction. But such waves are incompatible with the law of entropy. In an explosive *condensational* wave heat is produced by the friction between parts of the gas which move with different velocities, as Hugoniot's law clearly shows, and an increase of entropy results. The inverse phenomenon—the transformation into kinetic energy of the internal energy of the gas by means of friction—which would involve a diminution of entropy, cannot occur, so that negative waves of explosion—those of dilatation moving towards the denser parts of the gas—cannot persist even if momentarily generated. **Hadamard.** (Comptes Rendus, 141. p. 713, Nov. 6, 1905.)—Hadamard, commenting on the above, points out that the entropy of a gas depends on the product pv^κ, and, with Hugoniot's law, this is the greater in the more condensed part of the gas, so that Zémplen's conclusion directly follows. R. E. B.

126. *Momentum and Pressure of Gaseous Vibrations and Connection with Virial Theorem.* **Rayleigh.** (Phil. Mag. 10. pp. 364–374, Sept., 1905.)—The author previously considered the case of a gas obeying Boyle's law and vibrating within a cylinder in one dimension. It appeared that in consequence of the vibrations, a piston closing the cylinder is subject to an additional pressure whose amount is measured by the volume-density of the total energy of vibration [see Abstract No. 1248 (1905)]. More recently, J. H. Poynting has treated certain aspects of the question, especially the momentum associated with the propagation of progressive waves. Thus prompted, the present author here returns to the consideration of the subject, and has arrived

at some more general results, which, however, do not in all respects fulfil the anticipations of Poynting. The paper commences with a calculation similar to that given before, but applicable to a gas in which the pressure is any arbitrary function of the density. The general result obtained expresses the mean additional pressure upon the piston in terms of the mean kinetic energy as follows :—

$$\int(p_1-p_0)dt=\left\{\rho_0+\frac{\rho_0{}^2f''(\rho_0)}{2f'(\rho_0)}\right\}\int\int\frac{U^2\,dx\,dt}{l}. \quad \text{..........(1)}$$

In this the p's denotes pressures, the ρ's densities, $p=f(\rho)$, the accents to the f's denoting derived functions, U denotes the resultant velocity at point x at time t, and l is the length of the cylinder parallel to x. Among special cases, that of Boyle's law is first taken, where $p=a^2\rho$. So that $f'(\rho_0)=a^2, f''(\rho_0)=0$. Hence—

$$\int(p_1-p_0)dt=\rho_0\int\int\frac{U^2\,dx\,dt}{l}. \quad \text{......................(2)}$$

The expression on the right represents double the volume-density of kinetic energy, or the volume-density of the whole energy ; thus agreeing with the result of the former investigation. According to the adiabatic law $p/p_0=(\rho/\rho_0)^\gamma$, so that $f'(\rho_0)=p_0\gamma/\rho_0$ and $f''(\rho_0)=p_0\gamma(\gamma-1)/\rho_0{}^2$. Thus, from (1) is obtained for this case—

$$\int(p_1-p_0)dt=\tfrac{1}{2}(\gamma+1)\rho_0\int\int\frac{U^2\,dx\,dt}{l}. \quad \text{..............(3)}$$

Hence the mean additional pressure upon the piston is now $(\gamma+1)/2$ of the volume-density of the total energy. We fall back on Boyle's law by taking $\gamma=1$. It appears, therefore, that the result is altered when Boyle's law is departed from. Still more striking is the alteration when we take the case treated in "Theory of Sound," § 250, of the law of pressure—

$$p=\text{constant}-a^2\,\rho_0{}^2/\rho.$$

According to this $f'(\rho_0)=a^2$ and $f''(\rho_0)=-2a^2/\rho_0$. Then (1) gives for this case—

$$\int(p_1-p_0)dt=0 \text{..............................(4)}$$

The law of pressure here used is that under which waves of finite condensation can be propagated without change of type. In (4) the mean additional pressure vanishes, and the question arises whether it can be negative. It would appear so. If, for example, $p=\text{const.}-a^2\rho_0{}^3/2\rho^2$; then $f'(\rho_0)=a^2$, $f''(\rho_0)=-3a^2/\rho_0$, and—

$$\int(p_1-p_0)dt=-\tfrac{1}{2}\rho_0\int\int\frac{U^2\,dx\,dt}{l}. \quad \text{..................(5)}$$

The question of the momentum of wave-trains is then considered, and it is shown that—

$$\text{momentum}=[\rho_0f''(\rho_0)/4a^3+1/2a]\times\text{total energy.........(6)}$$

the a now denoting the velocity of infinitely small waves. This may be compared with (1). If we suppose the long cylinder of length l to be occupied by a train of progressive waves moving towards the piston, the integrated pressure upon the piston during a time l/a should be equal to twice the momentum of the whole initial motion. The two formulæ are thus in accordance and (6) needs no detailed discussion. It may suffice to call attention (1) to Boyle's law, where $f''(\rho_0)=0$, and (2) to the law of pressure leading to (4) under which second case progressive waves have *no momentum*. It would seem that pressure and momentum are here associated with the tendency of waves to alter their form as they proceed on their course. The paper closes with a discussion of the subject from the standpoint of the kinetic theory of gases, equation (1) being simply derived from the virial theorem of Clausius. [See also Abstracts Nos. 1495 (1902) and 1877 (1905).] E. H. B.

127. *Saturation Pressures of Steam.* **K. Scheel.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 391–394, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 867–868, Dec. 1, 1905. Communication from the Physikal.-Techn. Reichsanstalt. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 26–30, 1905.)—The theoretical formula, $\log p = a - b \log T - c/T$, for the saturation-pressure of a vapour, which conforms approximately to the gaseous laws, expresses very satisfactorily the observations of Regnault, Juhlin, and Marvin for the saturation-pressure of steam in contact with (1) water between 20° and —20° C. if $a = 23{\cdot}58682$, $b = 5$, $c = 2933{\cdot}45$; (2) ice between 0° and —50°, if $a = 11{\cdot}4796$, $b = 0{\cdot}4$, $c = 2687{\cdot}4$; (3) dilute H_2SO_4 between 10°·7 and 35°·35, if $a = 16{\cdot}90367$, $b = 2{\cdot}80135$, $c = 2703{\cdot}68$, the logarithms being all common. R. E. B.

REFERENCES.

128. *Ratio of the Specific Heats for Ozone.* **A. Jacobs.** (Beibl. Ann. d. Physik, 29. 18. p. 951, 1905. Extract of Inaug. Dissertation, Marburg, 1904.)—Mixtures of oxygen and ozone are used. The method of Kundt's dust figures is employed, the source of sound being a specially constructed glass whistle. The ratio of the specific heats, c_p/c_v, for ozone is found by an extrapolation formula to be 1·29. S. G. S.

129. *Virial Equation.* **S. H. Burbury.** (Phil. Mag. 10. pp. 33–35, July, 1905.) —A symmetry assumed for a fluid by Rayleigh [see Abstract No. 1248 (1905)] is inconsistent with Boltzmann's e^{-2hx} law. R. E. B.

130. *Heat Radiation of Metals.* **E. Aschkinass.** (Deutsch. Phys. Gesell., Verh. 7. 13. pp. 251–254, July 15, 1905. Ann. d. Physik, 17. 5. pp. 960–976, Sept. 26, 1905. Phys. Inst. d. techn. Hochschule, Charlottenburg, June, 1905.)—A discussion of the relation between percentage reflection coefficient of a metal for infra-red rays and its electric resistivity in the light of the theories of Drude and Planck, and the experiments of Lummer and Kurlbaum and the present author. A fuller paper is shortly to appear. E. H. B

131. *Thermal Effects in Compressors.* **F. L. Richter.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 1101–1108, July 8; 1200–1207, July 22, and pp. 1276–1282, Aug. 5, 1905. Communication from the Maschinen-laborat. d. techn. Hochschule, Charlottenburg.)—The machine used in the researches described was a single-cylinder combined steam and air compressor, which is described in detail. The effects of various factors are dealt with, *e.g.*, loss through adiabatic expansion in the clearance spaces and through absorption of heat during expansion, &c. The chief interest of the papers lies in the very numerous diagrams and tables of results. A. W.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

132. *Electrodynamics in Moving Media.* **R. Gans.** (Ann. d. Physik, 18. 1. pp. 172–186, Oct. 12, 1905. Phys. Inst., Tübingen, Aug. 14, 1905.)—A second communication on this subject in which the following points may be specially noticed, the paper being too analytical for detailed abstraction. (1) In the treatment of the moving mirror it is shown that the normal radiation-pressure has the same value on the theories of Cohn and of Lorentz. (2) On account of the earth's motion, perfect vacuum is shown to appear æolotropic, with the symmetrical properties of a uniaxal crystal, whose optic axis is along the direction of the earth's motion. (3) The force of translation on a condenser in a perfect vacuum is the same as according to the original theory of Lorentz. (4) In a perfect vacuum the effect sought by Trouton and Noble must, according to Cohn's theory, appear. [See also Abstracts Nos. 1727, 2147 (1904), and 338, 1257 (1905).] E. H. B.

133. *Does the Inertia of a Body depend upon its Energy?* **A. Einstein.** (Ann. d. Physik, 18. 3. pp. 639–641, Nov. 21, 1905.)—Attacking this question on the basis of the Maxwell-Hertz equations, the author arrives at the following conclusions: If a body parts with energy L in the form of radiation, then its mass is reduced by the value L/V^2, where V is the speed of light. Thus, the mass of a body is a measure of its energy-content, so that if its energy changes by L, then the mass changes in the same sense by $L/(9 \times 10^{20})$, if the energy is in ergs and the mass in gm. This result, theoretically obtained, awaits experimental confirmation. [See also Abstract No. 2277 (1905).] E. H. B.

134. *Reflection of Electric Waves at a Wire.* **W. v. Ignatowsky.** (Ann. d. Physik, 18. 3. pp. 495–522, Nov. 21, 1905.)—A mathematical treatment (by means of Hankel's cylinder-functions) of the problem of the reflection and absorption of electromagnetic waves incident on a wire, (1) with axis parallel to the electric force in the wave-front, (2) with axis perpendicular to the electric force. The author shows that in the first case much is reflected and much absorbed, the absorption being due to currents in the wire; while in the second case little is reflected and little absorbed. E. H. B.

135. *Electromagnetic Field of Damped Waves near a Linear Oscillator.* **F. Hack.** (Ann. d. Physik, 18. 3. pp. 634–638, Nov. 21, 1905.)—The problem of the radiation from a linear oscillator of damped waves is here mathematically treated and compared with undamped radiation. The two results are contrasted by full and dotted lines on three diagrams showing different stages of the process. For the cases considered the distinction between the fields for damped and undamped waves is small and usually negligible. [See Abstract No. 2655 (1904).] E. H. B.

136. *Specific Velocity of Positively-charged Carriers of Atmospheric Radioactive Induction.* **H. Gerdien.** (Phys. Zeitschr. 6. pp. 465–472, Aug. 1, 1905.

Geophys. Inst., Göttingen, June, 1905.)—The method used by the author in these investigations consists in drawing the air to be examined between the electrodes of a cylinder condenser, the inner electrode being negatively charged with respect to the outer one. The positive carriers of the radioactive induction, if they have a specific velocity of measurable magnitude, will then precipitate themselves with a regularly varying surface density on the inner electrode. This surface density—a function of the variables of the experiment—can be determined by subsequently decomposing the inner electrode into intervals along its whole length, these intervals being then separately investigated as to their ionising action. The results obtained show that, with the positive carriers of radium-inductions in the atmosphere, specific velocities occur varying between 5,250 electrostatic units and the one-tenth part of this value. The latter minimum value is of about the same magnitude as the specific velocity of the negative ions in air at ordinary pressure. T. H. P.

137. *Electricity Dissipation on and near the Puy de Dôme.* **B. Brunhes** and **A. Baldit.** (Comptes Rendus, 141. pp. 693–695, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 715–718, Oct. 26, 1905. Paper read before the Liége Congrès de Radiologie.)—Observations were made in the autumn and winter of 1904 and the summer of 1905, with the aid of Elster-Geitel apparatus and a Curie electroscope (not portable); the charge of raindrops was investigated by removing the lower condenser plate. The positive dissipation increases at once when mists or rain appear; the smoke from burning leaves also influenced the instruments, even before the smoke was seen or smelt. Changes were observed at sunrise and sunset. The observations at different levels, on hills rising more or less above the plateau, and while ascending and descending, indicate that at least for elevations up to 1,500 m. the asymmetry between the dissipations of the two electricities depends more upon the configuration of the country than upon the altitude, and that the increase of the electric field near the summits is due rather to a decrease in the positive than to an increase in the negative dissipation. H. B.

138. *Electric Dispersion.* **C. Carpini.** (Elettricista, Rome, 4. pp. 296–298, Nov. 1, 1905.)—The first part of the paper describes measurements of the electric dispersion of the air in the caves at a hot mineral spring (Acquasanta). It is found that the dispersion is less within the caves than in the outside air; hence the therapeutic properties of the waters cannot be due to radio-activity. The second part consists of results of measurements of electric dispersion, barometric height, relative humidity, and absolute humidity made at Monterubbiano, 365 m. above the sea-level. The curves indicate clearly that a rise in the dispersion for both + and — charge is always accompanied by a drop in the relative humidity, and *vice versâ,* and is not apparently affected by changes in the absolute humidity. At this altitude the dispersion is slightly greater for a — than for a + charge. These results are in accord with those of Elster and Geitel. [See Abstract No. 1281 (1900).] S. G. S.

139. *Electric Dispersion of the Atmosphere.* **G. Berti** and **I. Canestrelli.** (Elettricista, Rome, 4. pp. 313–314, Nov. 15, 1905.)—Some observations of electrical dispersion at altitudes varying from 990 to 2,921 m. made in June, 1902, are given, and several conclusions drawn from them. With a rise in atmospheric potential the coefficient of dispersion for a negative charge

increases, but no corresponding change could be found in the case of a positive charge, perhaps on account of the smallness of the coefficient in this case. Another effect, chiefly observed at the summits of mountains, is that the coefficient of dispersion for a negative charge is much greater when the apparatus is 1 or 2 m. above the ground than when resting on the ground, but no such difference is found in the case of a positive charge. S. G. S.

140. *Atmospheric Electricity during the Solar Eclipse, August* 30, 1905. **G. Le Cadet.** (Comptes Rendus, 141. pp. 925–928, Nov. 27, 1905.)—The observations were made in the gardens on the large plains east of the Ebro Observatory near Tortosa-Roquetas with the aid of apparatus of Exner and Gerdien (aspirator) and an acetylene lamp collector (Elster-Geitel). The electric field varied considerably during the eclipse, between 110 and 160 volts/m., there being a minimum (66 volts) 12 min. after the end of totality, and rose again to 150 volts in the subsequent 16 min. The electrolytic conductivity of the air decreased noticeably during the first half of the eclipse and recovered slowly afterwards. This may be due to a diminution in the mobility of the ions, and connected with an increase in the humidity during the eclipse. But there seemed, further, to be a diminution in the ionisation, which the decrease of solar radiation could explain. The sky became clouded and the sun obscured during the eclipse; by the time that the minimum field strength was observed, the sun was free again. H. B.

141. *Maintenance of Earth's Normal Electric Field.* **H. Ebert.** (Phys. Zeitschr. 6. pp. 825–828, Dec. 1, 1905.)—The hypothesis that the vertical electric field near the earth is maintained by the action of positive and negative ions has previously been put forward by the author. It has since been admitted by G. C. Simpson that this theory is based upon a process which really occurs in nature, the only question still left open being the point as to whether the magnitude of the effect is sufficient to account for the field in question. The present paper discusses this quantitative aspect of the subject and shows that the process allows of that multiplicity of variations needed in any hypothesis competent to account for the electric field of the earth's atmosphere. [See also Abstracts Nos. 1172, 2988, 3273 (1904) and 193 (1905).] E. H. B.

DISCHARGE AND OSCILLATIONS.

142. *Experiments on the Hallwachs and Le Bon Effects.* **O. Nothdurft.** (Beibl. Ann. d. Physik, 29. 10. pp. 526–527, 1905. Extract of Inaug. Dissertation, Freiburg, 1904.)—The Le Bon-effect, that an illuminated metal plate gives out a radiation which is capable of discharging a positively charged body, is shown to be closely related to the Hallwachs-effect [see Abstracts Nos. 840 and 841 (1904)]. Also the effect given by Lenard, that lampblacked surfaces show a very constant photo-electrical effect is examined. Again, this effect is increased in the case of Pt when charged with hydrogen, and diminished when charged with oxygen. S. G. S.

143. *Velocity of Ions in the Gases of Coloured Flames.* **Berkeley** (P. Lewis). (Phys. Rev. 21. pp. 353–366, Dec., 1905. Phys. Zeitschr. 6. pp. 726–728, Oct. 26, 1905.)—The author finds that the rate of discharge of an electroscope is considerably diminished when the instrument is brought near

to a Bunsen flame into which a salt of an alkali metal is introduced. The velocity of the ions of a colourless flame is not altered by injecting either distilled or conductivity water into the flame. Experiments with salt solutions show that: (1) the velocity of ions of the same sign from equimolecular solutions of all alkali metals is very approximately the same; (2) the velocity of all ions of the same sign from equimolecular solutions of salts of the calcium group is the same and somewhat less than one-half of the corresponding velocity in the case of the alkali metals; (3) the velocity of the negative ions is somewhat less than that of the positive ones; (4) the specific velocity of the ions varies inversely as the square root of the concentration. Comparison with the results obtained by Wilson [Abstract No. 1722 (1899)] shows that the velocities of the ions and also the difference between the velocities of positive and negative ions diminish very rapidly as the temperature falls. T. H. P.

144. *Conductivity of the Gases proceeding from Flames.* **E. Bloch.** (Journ. de Physique, 4. pp. 760–768, Nov., 1905. Paper read before the Soc. franç. de Physique, June 2, 1905.)—The ratio of the number of recombinations to the total number of collisions of ions of opposite sign [see Abstract No. 163 (1905)] has the value 0·27, which tends to unity as the mobility of the ions decreases. For flame gases the values of the mobility found by McClelland and the author do not agree, and experiments are made to find the cause of discrepancy. In the results obtained, the saturation curves for the ionised gases lie farther and farther below the theoretical curve as the time of passage of the gases through the measuring apparatus is increased, and the mobility becomes less sharply defined, finally reaching the value 0·01 [see also Abstract No. 1482 (1905)]. The gases from a flame, therefore, contain ions of which the mobility decreases to a stable value in 15 to 20 min. G. E. A.

145. *Rate of Recombination of Ions in Air.* **L. L. Hendren.** (Phys. Rev. 21. pp. 314–334, Nov., 1905.)—J. J. Thomson and Rutherford give the law, $dp/dt = dn/dt = -\alpha np$, where p and n are the positive and negative electrical densities, and α the coefficient of recombination. McClung [see Abstract No. 1350 (1902)] found that α was independent of the pressure, while Langevin obtained a rapid decrease. The purpose of the work described was to obtain additional data as to the variation of α with pressure, and also to obtain values below the limits of pressure previously used. McClung's and Langevin's methods are criticised. The method adopted by the author was similar to that of McClung, but radium was used instead of Röntgen rays. By using radium greater ionisation was obtained, and no difficulty due to the inconstancy of the radiation was encountered, as is the case with Röntgen rays. The results obtained could not be easily compared with Langevin's, as the methods are different, but in a general way Langevin's results are confirmed, as there is a decrease of α with pressure. The tabulated results show a variation of α from 3,300 at 760 mm. to 1,550 at 100 mm. and 1,000 at 10 mm. All the objections to McClung's experimental conditions were met, except that due to uneven distribution; but it is shown that a considerable divergence from a uniform distribution could not affect the value of α very much. [See also Abstract No. 355 (1905).] A. W.

146. *Researches on the Electric Arc.* **J. Stark, T. Retschinsky,** and **A. Schaposchnikoff.** (Ann. d. Physik, 18. 2. pp. 213–251, Nov. 7, 1905. Écl. Électr. 45. pp. 481–488, Dec. 30, 1905, and 46. pp. 5–10, Jan. 6, 1906.)—

The paper begins by a theoretical discussion, based upon the electronic hypothesis, of the causes of the kathode- and anode-fall in the electric arc, and of the dependence of these upon the physical conditions under which the arc exists. Much of it has been given in previous papers [see Abstracts Nos. 2298, 2359B, 2669 (1904), and 1030 (1905)]. Researches were conducted on mercury, carbon, and copper arcs, measurements being made of the kathode- and anode-falls at the actual electrodes and at probe electrodes situated on the same equipotential surface of the arc column. To the latter a battery of 8 volts was connected and a cross-current of the order of 0·2 milliamps. obtained, which was dependent for its existence on the ionisation of the gas. The kathode- and anode-falls in such a cross-current are proportional to the specific velocities of the negative and positive ions in the vapour of the arc. The general results obtained are as follows: The potential-fall in the arc column is greater for an atmosphere of H than for one of CO_2. With Cu the difference is greater than with carbon electrodes. The phenomenon is to be explained by the cooling effect of the surrounding atmosphere on the arc, and on the electrodes. The kathode-fall in a cross-current in rarefied H is about ten times greater than the anode-fall. The same is true for Hg vapour, and for a carbon arc in air. It is to be ascribed to the great difference between the specific velocities of the negative and positive ions in the arc column. The kathode-fall in an arc of Hg vapour at a mercury electrode is independent of the current strength. The anode-fall depends upon a number of things, but, in general, it increases somewhat with current strength if the anode is quite covered with glow. The fall of potential at a hot anode is greater than that at a cooled anode, and the anode-fall is reduced if the kathode glow extends to it. Increase in the density of the vapour in the neighbourhood of the anode diminishes the fall. The latter also depends upon the anode material. J. D. C.

147. *Transit of Ions in the Electric Arc.* **A. A. Campbell Swinton.** (Roy. Soc., Proc. Ser. A. 76. pp. 553–556, Dec. 6, 1905.)—J. J. Thomson has explained the electric arc on the assumption that the electrodes emit positive and negative ions, which travel across the space occupied by the arc and bombard the electrode opposite to that from which they start. The author proves this experimentally. One carbon electrode, A, is hollow and contains an insulated Faraday cylinder, connection being made through a galvanometer between electrode and cylinder. If the other electrode, B, is made positive, the cylinder acquires a positive charge due to the ions shot into it from B. If the polarity of the arc is reversed, so is the charge of the cylinder. If a magnet is used to deflect the arc from the aperture of A, then the cylinder does not gain a charge. R. S. W.

148. *Discharge by a Ruhmkorff Coil.* **L. Amaduzzi.** (N. Cimento, 10. pp. 79–89, Aug., 1905.)—The experiments previously described [see Abstract No. 580 (1905)] are repeated and extended, in order to investigate their cause. A variable capacity is placed between the terminals of the secondary with the object of seeing whether the phenomenon is due to resonance between the primary and secondary coils. On varying this capacity, changes in the character of the spark were obtained, but they were not of the same character, nor were they so distinct as those produced by varying the resistance and inductance of the primary. The experiments were therefore inconclusive. The author next used a vacuum tube instead of the atmosphere for the medium in which the discharge takes place; but no distinct

variations are observed in this case. On varying the effective area of the anode of the electrolytic interrupter by immersing the Pt wire to a greater or less depth, alternations in the discharge are produced, similar to those observed on varying the resistance and inductance. The reaction of the secondary upon the primary is shown by placing a voltmeter as shunt across the interrupter and one of the inductance coils; as the distance apart of the spark-electrodes is diminished, the reading of the voltmeter falls when the condition for linear spark discharge is reached, and rises rapidly when the flame discharge is produced. S. G. S.

149. *Spark Discharge in Gases.* **W. Voege.** (Ann. d. Physik, 18. 3. pp. 606–616, Nov. 21, 1905. Phys. Staatslaborat, Hamburg, Sept., 1905. Écl. Électr. 46. pp. 25–26, Jan. 6, 1906.)—The author has repeated the measurements of Orgler [see Abstract No. 506 (1900)] with regard to spark potentials, and found a close agreement. With a spark-gap of less than 8 cm., and ionisation by Röntgen rays, CO_2 is more easily traversed than air. But at longer sparking distances this relation is reversed, and CO_2 acquires the greater dielectric strength. The definition of the latter should therefore be based upon measurements made with spark-gaps longer than 8 cm. Oxygen appears to offer a characteristic and large transition resistance, possibly due to ozone formed. The sparks in various gases may be readily distinguished by their appearance. In air the spark is white, irregular, and noisy. In oxygen it is violet; in CO_2, blue, except with great current densities, where the evolution of oxygen gives it a violet colour. In hydrogen the spark is straight, red, and noiseless. The influence of the gas may be explained on the ionic theory. Positive ions reduce the kathode-fall, and H, having a tendency to give up its spare electrons, acts somewhat as if it consisted of positive ions. Nitric oxide ions are negative with respect to air, and therefore, like Cl, impede the discharge. E. E. F.

150. *Glow Discharge in the Halogens.* **W. Matthies.** (Ann. d. Physik, 18. 3. pp. 473–494, Nov. 21, 1905. Phys. Inst. d. Univ., Erlangen, July 28, 1905. Écl. Électr. 46. pp. 61–64, Jan. 13, 1906.)—In connection with the researches on the spark potential in the halogens [see Abstracts Nos. 2263 (1904) and 1618 (1905)], the author measures the potential gradient in chlorine, bromine, and iodine, using five platinum probes in fixed positions in the vacuum tube. The results show that both qualitatively and quantitatively there is great similarity between the behaviour of the haloid compounds of mercury and that of the pure halogens. They do not behave in a manner essentially different from nitrogen. But the gradients are much steeper in the halogens, and steeper yet in the mercury haloids. Iodine has the smallest, and bromine the greatest gradient. In the unstratified positive column the gradient is not constant, but increases in passing from the kathode to the anode. With increasing pressure the gradients also increase, but more and more slowly. The relation between gradient and current strength is linear for small regions among the greater current strengths. The normal kathode-fall increases with the molecular weight, being 295 in chlorine, 335 in bromine, and 377 in iodine. The differences between these values and the corresponding values for the mercury haloids are approximately equal. E. E. F.

151. *Actino-electric Phenomena.* **H. Dufour.** (Phys. Zeitschr. 6. pp. 872–877, Dec. 1, 1905. Paper read before the Liége Congrès de Radiologie.)—An examination of various forms of radiation as to their discharging effects. The radiators examined included an arc lamp, an Auer incandescent burner,

a Nernst lamp, and a small electric stove yielding chiefly red and infra-red rays. The bodies exposed to radiation were amalgamated zinc, as being sensitive to ultra-violet light; an Auer mantle; wire gauze, both bare and blackened, and having a large surface for adhering gases, and various organic and phosphorescent substances. The arc only discharges negatively-charged bodies, and especially amalgamated zinc. This substance exhibits some fatigue after half an hour's exposure, and the dissipation of the charge then proceeds at half the original rate. A burnt-out incandescent mantle shows no such fatigue. Infra-red rays emitted by an electric furnace neutralise the visible rays of other radiators as regards the electric discharge. When the furnace is made gradually hotter, the rate of discharge of negatively charged bodies increases rapidly. It is as yet undecided whether the effect of the furnace is due to waves of short length or to some corpuscular radiation of positive ions. E. E. F.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

152. *Quartz Fibres made Conductive.* **A. Bestelmeyer.** (Zeitschr. Instrumentenk. 25. pp. 339–340, Nov., 1905. Phys. Inst. d. Univ., Göttingen, Oct. 11, 1905.)—Of the three ways in which a charge is given to the needle of a sensitive electrometer without sulphuric vessel, the silvering of the fibre (Himstedt) seriously reduces its elasticity; wetting the fibre with a hygroscopic solution (Dolezalek) prevents thorough drying of the electrometer; and charging an insulated needle by single contact with the charged body entails gradual discharge of the needle. To overcome these disadvantages, the author renders quartz fibres conducting by subjecting them to kathode rays. The fibre is hung within a vacuum tube from two points in metallic connection with the outside, one of the supports being the anode, and is platinised from a Pt-wire kathode. The tube, evacuated to about 0·1 mm. of Hg, is worked by a high-tension battery of 1,280 volts, and the conductivity of the fibre can be tested from time to time with an electroscope. G. E. A.

153. *Variation of the Potential in a Direct-current Circuit.* **Vanni.** (Écl. Électr. 45. pp. 189–191, Nov. 4, 1905.)—The potential differences between points on a direct-current circuit of high resistance and earth are found by means of a Braun electrometer furnished with a metallic disc condenser. The agreement with Ohm's law is quite satisfactory, This arrangement can be used to calibrate a gold-leaf electroscope. The variation in the capacity of the metallic disc condenser can also be found from the voltage readings. A. R.

154. *Electric Conductivity and Reflection Coefficient of Coal.* **E. Aschkinass.** (Ann. d. Physik, 18. 2. pp. 373–386, Nov. 7, 1905. Phys. Inst. d. techn. Hochschule, Charlottenburg, Aug., 1905.)—Good conductors of electricity should be good reflectors of electro-magnetic waves on theoretical grounds; thus metals are almost perfect reflectors. Next to the metals we have as fairly good conductors some kinds of coal, which should accordingly be good reflectors of electric waves, though almost total absorbers of the light forming the visible spectrum. The experiments here described confirm this expectation. Several kinds of coal, though of typically black appearance, behaved like a bright metal towards Hertzian waves several cm. in length. [See also Abstracts Nos. 63 and 558 (1904).] E. H. B.

155. *Thermo-electricity.* **E. Lecher.** (Deutsch. Phys. Gesell., Verh. 7. 21. pp. 331–339, Oct. 30, 1905. Phys. Zeitschr. 6. pp. 781–785; Discussion, p. 785, Nov. 9, 1905. Paper read before the 77 Naturforscherversamml. at Meran, Sept. 24–30, 1905.)—The paper is divided into two parts—a description of experimental results being given first, and from these theoretical deductions are made. Curves are given showing the Thomson-effect for Ag, Cu, Fe, and constantan per coulomb per 1° C. difference of temperature. Ag and Cu give little variation between 100° and 500°, but iron shows a minimum value at about 200°, of -4×10^{-6} gm.-cal. Other curves are given showing the conduction of heat per coulomb for the same metals, and these are discussed at length with the aid of several other diagrams. A. W.

156. *Separation of a Colloid in the Electric Current.* **A. Schmauss.** (Ann. d. Physik, 18. 3. pp. 628–633, Nov. 21, 1905. Phys. Inst. d. Univ., München.) —It is known to be an essential property of colloidal solutions, that on the passage of an electric current the dissolved particles separate out on the two electrodes. J. Billitzer has shown that these colloid particles behave like ions, and that their passage across in the current corresponds to a kind of electrolysis. The present author now shows that each ion condenses upon itself several colloid particles until the charge is thus neutralised. [See also Abstracts Nos. 1169 (1903), 2999 (1904), and 492, 2000 (1905).] E. H. B.

157. *Determination of Self-induction.* **W. Peukert.** (Elektrotechn. Zeitschr. 26. pp. 922–923, Oct. 5, 1905. Écl. Électr. 45. pp. 194–196, Nov. 4, 1905. Elect. World and Engineer, 46. p. 743, Oct. 28, 1905.)—This paper describes a new method for determining the coefficient of self-induction, the principle being illustrated in the following manner. On a bobbin S is wound a coil of resistance r and self-induction L. In parallel with this coil are placed an induction-free resistance R and a capacity C. If a simple alternating e.m.f. be produced in the coil, then an alternating current with a phase difference ϕ results. The impedance of the circuit is shown to be equal to—

$$\sqrt{\left[r + R/\sqrt{1 + \omega^2C^2R^2}\right]^2 + \left[\omega L - R/\sqrt{1 + \omega^2C^2R^2}\right]^2},$$

and the phase difference ϕ is given by the equation—

$$\tan\phi = \frac{\omega L - R/\sqrt{1 + \omega^2C^2R^2}}{r + R/\ \overline{1 + \omega^2C^2R^2}},$$

where $\omega = 2\pi/T$. From the latter equation it is evident that $\tan\phi = 0$ when $L = R/\omega\sqrt{1 + \omega^2C^2R^2}$, and it thus becomes possible, by using a sensitive phase-indicator, to determine L from a knowledge of ω, R, and C. The phase equality is determined in the following manner. The coil S is suspended from an arm of a sensitive balance and is counterpoised. Directly underneath it a second coil is placed, and through this an alternating current passes. An e.m.f. is thus induced in the movable coil, and, unless the condition expressed by the last equation is fulfilled, the phase difference between the induced and inducing currents will be different from 90°, and the equilibrium of the balance will in consequence be disturbed. The adjustment is made by varying R and C. The leads to the moving coil must exert very little force on the beam of the balance, and the induced current should not be so great as to unduly heat the resistance R. **H. Zipp.** (Elektrotechn. Zeitschr. 26. p. 1087, Nov. 23.)—Zipp remarks on the self-induction values obtained by Peukert, these values appearing to be abnormally high when compared with the values for other coils of comparable dimensions, and measured by Zipp by Rimington's method. An error in one of the formulæ was sought and from other considerations than those employed by Peukert, the formula $L = CR^2/(1 + \omega^2C^2R^2)$ is obtained for Peukert's method. Since C is in mfd. the term $\omega^2C^2R^2$ is small and negligible, and the equation becomes $L = CR^2 10^{-6}$ henry, and not $L = R/\omega$, as obtained by Peukert when the term $\omega^2C^2R^2$ is neglected. Thus the coils which Peukert determined as having values of $L = 0{\cdot}017$ and 0·057 henry respectively, have much smaller values than these, the re-calculated values being 0·00024 and 0·0033 henry. **W. Peukert.** (Ibid. p. 1087, Nov. 23.)—Peukert, in replying to Zipp's criticism, regrets the error which crept into his paper, and acknowledges his indebtedness to Zipp, whose formula he corroborates. F. E. S.

158. *Standards of Mutual Induction.* **G. F. C. Searle.** (Electrician, 56. pp. 318–321, Dec. 8, 1905.)—The arrangement ascribed to Kelvin consists of a primary coil uniformly wound upon a circular cylinder, the length of the coil being great in comparison with the diameter. The secondary coil is of fine wire, and is wound on the outside of the primary coil, or preferably on an accurately measured cylinder placed within the primary and coaxial with it. In each case the secondary occupies a central position, and its length is small in comparison with that of the primary. The author explains a method of calculating the mutual induction to any desired degree of accuracy when the secondary lies within the primary coil, the theory enabling the value of M to be found accurately for coils which are much more compact than those sometimes employed. The value of M is shown to be given by the rapidly converging series—

$$M = \frac{2\pi^2 N n a^2}{C}\left(1 - \frac{A^2}{2C^4}\cdot\frac{4l^2 - 3a^2}{4} - \frac{A^2(4L^2 - 3A^2)}{80^8}\cdot\frac{8l^4 - 20l^2a^2 + 5a^4}{8} - \cdots\right),$$

where N and *n* are the number of turns of wire on the primary and secondary coils respectively, 2L and 2*l* their lengths, A and *a* their radii, and C^2 a constant equal to $L^2 + A^2$. The principal term, $2\pi^2Nna^2/C$, in the series is the value which results for M if it is assumed that at every point within the secondary coil the magnetic force due to unit current in the primary coil is uniform in direction and of the constant value $2\pi N/C$. The effect of a small displacement of the secondary coil is also considered, and particulars are given relating to the practical construction of the standard, two illustrations appearing in the paper of one such made by W. G. Pye & Co., of Cambridge. F. E. S.

159. *Hartmann's Photophone.* (West. Electn. 37. p. 141, Aug. 19, 1905.)—In the transmitter of this instrument a convergent pencil of light is projected, by means of an elliptic mirror, on to a small plane mirror mounted on a diaphragm which receives the sound waves through a mouthpiece. From the plane mirror the light passes through a kind of eyepiece to an objective which sends out a parallel beam of light to a receiver. The receiver comprises an objective which focusses the parallel beam through a pin-hole stop on to a selenium cell connected to any ordinary telephone receiver. An electric arc is used as a source of light in the elliptic mirror. C. K. F.

160. *Induction Galvanometer for Solidification and Critical-temperature Work.* **Dejean.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 701–704, Aug., Sept., Oct., 1905.)—The apparatus is designed to automatically record both solidification and critical points: Roberts-Austen's does not, in general, conveniently register both; Osmond's gives them, but does not lend itself to automatic recording. The induction galvanometer, of Desprez-d'Arsonval type, with electromagnet, has two windings on the moving bobbin; one is connected to a thermo-couple in the specimen, the other to a second galvanometer; movement due to a current in the one winding induces a current in the second winding. The movements of the second galvanometer, a function of the rate of change of temperature, become ordinates, and actual temperatures (obtained by a second thermo-couple and third galvanometer) abscissæ on the record, by the reflection method [see Abstract No. 1279B (1904)]. A number of critical-point determinations with a series of iron-carbon alloys are given. F. R.

161. 5,000-*volt Generator Set.* **P. G. Nutting.** (Bureau of Standards, Bull. 1. 3. pp. 449–451, Nov., 1905.)—Ten small 500-volt Crocker-Wheeler bipolar dynamos, capable of giving 0·22 amp. as a maximum, are belt-driven by a 2-h.p. motor, the armatures being connected in series, thus giving 5,000 volts, and the fields in parallel, the latter being excited from a separate circuit. By means of a speed controller the voltage may be held constant, between 3,000 and 5,000 volts, to within 1 per cent. For gas-conductivity work requiring about 1 milliamp. a continuously variable resistance of about 5 megohms is necessary, furnished by amyl alcoholic cadmium iodide tubes; these are now being replaced by a wire and graphite rheostat. L. H. W.

162. *Detector for Small Alternating Currents and for Oscillations.* **L. W. Austin.** (Bureau of Standards, Bull. 1. 3. pp. 435–438, Nov., 1905.)—The author had previously observed that a copper sulphate cell with very unequal-sized copper electrodes showed an apparent rectifying effect for alternating currents of the frequency of telephonic currents. Further experiments are here described. The electrodes are made from the same No. 30 wire, the small one being from 1 to 40 mm. long and the larger 1 to 30 cm. long; these are polarised by an external p.d. obtained from a potentiometer. The sensitiveness under these conditions appears to be almost independent of the size of the smaller electrode. The relation between the direct current produced and the alternating p.d. applied is shown by a curve. The lowest voltage observed when direct connected is about 1/10000 volt, but the sensitiveness is limited by the unsteady zero. Hertz waves were also found to affect the cell. Other metals in their own salts and in other electrolytes are less sensitive. For details the original should be consulted. [See also Dieckmann, Abstract No. 2281 (1904).] L. H. W.

163. *New Galvanometer.* (Elect. Rev., N.Y. 47. pp. 799–800, Nov. 18, 1905.)—A novel form of portable moving-coil galvanometer, patented by the Leeds and Northrup Co., of Philadelphia, is described. The moving system consists of four flat coils of very fine wire wound alternately in opposite directions, so as to produce alternate N & S poles when viewed from one side. These coils are held between two aluminium discs and suspended by top and bottom filaments of wire in such a manner that normally only a portion of each coil extends into the air-gap between the poles of a U-shaped

cast-iron permanent magnet. When a current is passed through the coils two of them, of like polarity, will swing round so as to enclose the greatest number of lines of force, while the other two will be repelled. The aluminium discs serve the purpose of damping the instrument and rendering its indications dead-beat. The coils can be connected in series, series-parallel, or all in parallel, giving high, medium, or low resistance to the instrument. As the coils are in disc form the air-gap between the poles of the magnet is short, so that its field is uniform and strong. E. C. R.

164. *New Interrupters.* (Zeitschr. Elektrotechn., Wien, 23. pp. 760–761, Dec. 17, 1905.)—Several newly patented interrupters are described. That of H. Scholler (D.R.-P. 161,646) is based upon the attraction exerted between the plates of a condenser on being charged, and the repulsion on discharge. Thin gelatine plates are used as dielectric, and the mechanical contraction on charging is used to bring the circuit-closing points, attached to the outer supports of the condenser, into contact, the points separating on the condenser discharging, owing to the repulsion between the plates. The number of interruptions can be made as high as 6,000 per sec., and the interrupter can be employed on direct- or alternating-current circuits from 30 volts upwards and with currents of 1/500 to 1/2 amp. No details are given.
L. H. W.

ALTERNATING CURRENTS AND MAGNETISM.

165. *Effect of Removal of Layer of Oxide on Permeability of Sheet-iron, Nickel, and Cobalt.* **H. Graziadei.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 843–876, June, 1905. Phys. Inst. d. Univ., Innsbruck.)—An induction balance method was employed. The samples were 32 cm. long by 5 mm. wide, the thickness being 0·2 to 0·6 mm. After preliminary treatment the samples were annealed and oxidised, magnetic and dimensional measurements were then made, and the specimens afterwards cleaned of oxide with fine emery—a process which, in the author's opinion, had little effect on the permeability. He finds generally that the effect of removing the scale is to reduce the remanent magnetism and also to reduce, except with strong fields, the hysteresis and the coercive force. He finds that the permeability is *decreased* by removing the scale—a result which is offered without explanation. [See also Abstract No. 2177 (1901).] D. K. M. and W. Ros.

166. *Malleable Magnetic Bronzes.* **F. Heusler.** (Beibl. Ann. d. Physik, 29. 23. p. 1238, 1905. From Gesell. Naturw. Marburg, Sitz. Ber., 1905.)—The author calls attention to the fact that the investigations of Fleming and Hadfield [Abstract No. 1637 (1905)] are only a confirmation of the measurements of Starck and Haupt on Mn alloys first prepared by himself [see Abstract No. 623 (1904) and the original paper, Gesell. Naturw. Marburg, Sitz. Ber. 13. 5. pp. 237–300, 1904]. The author's own further studies have shown that copper-rich Mn-Al bronzes of relatively high magnetic quality can be forged; quenched in water the forgings are almost non-magnetic, but they become magnetic on ageing. L. H. W.

167. *Magnetic Compounds from Non-magnetic Elements.* **E. Wedekind.** (Zeitschr. Elektrochem. 11. pp. 850–851; Discussion, p. 851, Nov. 24, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell., Karlsruhe, June 1–4, 1905.)—The boride, antimonide, arsenide, bismuthide, carbide, phosphide, and sulphide of manganese, in the form of powders or as the compact crude product, are all capable of magnetisation. The saturation-point of the boride is only reached in strong fields (1,100–1,800 units), *i.e.*, more than half as strong as for iron in the form of powder. The antimonide is saturated in a field of 650 units. The arsenide, prepared by the aluminothermic method, is non-magnetic unless heated up in the air. All these compounds possess a tolerably strong permanent magnetism, whether they be in the form of compact pieces or of compressed powders. The silicide of manganese is non-magnetic. The magnetic properties of the bismuthide are remarkable, since bismuth itself is diamagnetic. It was not possible to decide whether the fused compounds are conductors or not, as they are decomposed on heating in the air. T. S. P

168. *Determining the Magnetic Horizontal Intensity when Travelling.* **A. Wagner.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 1221–1229, July, 1905. From the Phys. Inst. d. Univ., Innsbruck.)—The principle of the new method is the following: When a freely suspended magnet is deflected by a bar magnet, the deflection will be the larger, the weaker the magnetic field of the earth; when this field is neutralised by solenoid currents, the needle will assume the direction of the deflecting magnet. The needle and a bar of copper are united to a cross and together pivoted in the usual way. The solenoid consists of a horizontal glass tube wound with 0·1 mm. copper wire. The whole is mounted on a Lamont stand. The deflecting magnet is first fixed in the plane of the magnetic meridian and then turned through 90°. The solenoid is afterwards alone turned until the needle, the deflection bar having been removed, keeps its position, whether the current be flowing or not. A somewhat similar, but far less accurate, determination with the aid of a telephone was proposed by G. Meyer in 1898. The author's measurements were correct within 0·06 per cent. of H, and he claims as advantages for his method: independence of time, of the constancy of the needle and bar magnet, of the solenoid currents and resistances; and that it is direct reading. H. B.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

169. *Action of Röntgen Rays on Osseous Tissue in Course of Development.* **Récamier.** (Archives d'Él. Médicale, 13. pp. 853–857, Nov. 25, 1905.)—The right side of the head of a kitten 4 days old was submitted to the action of the Röntgen rays for 10 min. This treatment was repeated on two other occasions in the same week, and the animal killed a month later. The following results were noticed: Vision of the right eye was almost abolished. The animal's snout was deviated slightly to the left, and this deviation concerned the skull as well as the soft parts, the bones forming the right of the face and the cranium being smaller than those on the left side. There was marked thinning of the right frontal and parietal bones, and in four places along the right half of the coronal suture there was complete absence of osseous tissue. H. W. P. Y.

170. *Use of Platinocyanide Pastilles in Radiotherapy.* **Bordier and Galimard.** (Archives d'Él. Médicale, 13. pp. 781–784, Oct. 10, 1905.)—Experiments are quoted to prove that the heat from the Röntgen-ray tube plays an

important part in the change of colour which pastilles of barium platinocyanide undergo during the working of the tube, and that since, according to the instructions of the inventors, the pastilles should always be placed at a distance of 8 cm. from the antikathode, they show a greater change of colour when large tubes are used because they are then closer to the glass and subjected to greater heat [see Abstract No. 1216 (1905)]. For example, when a tube of 16 cm. diam. was used, tint B was obtained in 9 min., while the dosage measured at the end of this period by Holzknecht's method was less than 3 H. The two methods gave similar results only when small tubes were employed. If correct measurements of dosage are to be obtained by Sabouraud and Noiré's pastilles there must be a different standard for each class of tube. **R. Sabouraud** and **H. Noiré.** (Ibid. pp. 884–885, Nov. 25.)—Sabouraud and Noiré, while admitting that heat may affect the pastilles of barium platinocyanide, point out that their radiometric value is not in any way diminished. This view is confirmed by the use of the static machine, for when this source of electricity is employed the production of Röntgen rays is proportional to the degree of redness of the antikathode, that is, to the heat disengaged. The fact that the change in the pastilles is produced almost equally with a tube with a cooled antikathode shows that it is produced by some other cause than heat. If large tubes are used it is only necessary to increase the distance at which the pastilles are placed in order to render negligible the action of heat. In their opinion small tubes are more suitable in many ways. They have used this method of radiometry in 5,000 cases of tinea tonsurous without accident; it is the most simple and least costly method. **H. Bordier** and **J. Galimard.** (Ibid. pp. 886–888, Nov. 25.)—Bordier and Galimard maintain that any form of tube may equally well be used in radiotherapy provided that accurate measurement of dosage can be assured, and they prefer those which have cooled antikathodes and which are self-regulating. Such tubes are always of large dimensions.

H. W. P. Y.

171. *Measurement of Faradic Currents.* **A. Broca.** (Archives d'Él. Médicale, 13. pp. 891–894, Dec. 10, 1905.)—By introducing between the two terminals of the secondary and those of a galvanometer a revolving commutator, similar to that of Ruhmkorff, and mounting an interrupter on the same axis, the two induced currents, make and break, are made to enter the galvanometer in the same direction. The deflection on the galvanometer is then equal to $A.n.q$, n being the number of induced currents per sec. and q the quantity in each. The factor A is the constant of the galvanometer for continuous currents. If a subject be placed in the circuit of the galvanometer he will receive currents of one direction only. Moreover, it is possible to communicate to him either the waves of closure or the waves of opening by using one pair only of the brush contacts of the commutator. In his experiment with this method the author uses a dynamo to drive the common axis of the commutator and interrupter, while the primary current is derived from an accumulator with a potentiometer arrangement. Within the limits of frequency attained (about 50 per sec. as a maximum) excitation is found to depend on the value of the wave and not on the number of waves per sec. The form of the wave is also of importance. At the point at which sensation is first felt the wave is longer for a low-voltage than for a high-voltage coil, but for the point of muscular excitation the wave is twice as long for the latter as for the former. A condenser placed in shunt to the patient has a much greater effect than when placed in series. H. W. P. Y.

172. *New Localiser for Radiotherapy and a New Protecting Material.* **J. Belot.** (Archives d'Él. Médicale, 13. pp. 834–844, Nov. 10, 1905.)—A detailed description is given of a new apparatus made by Gaiffe for the author. The protecting material employed is a special preparation of indiarubber which is stated to be practically impervious to the Röntgen-rays, permitting only 2 per cent. to pass through. Of this material a hemispherical mask is formed which partly surrounds the tube and has a tubular prolongation which protects the kathodal end. Opposite the antikathode is an orifice for the emission of the rays, and into this opening the localising tubes are fixed by a bayonet joint. These tubes are made of crystal, and are of varying sizes to suit different cases. Into this opening fits also the author's centreing apparatus. This consists of a tube having at its distal end a platinocyanide screen, and, at the proximal end, crossed metal wires. By means of an arrangement of screws the tube is adjusted into such a position within the hemisphere that the rays from the antikathode throw a shadow of the crossed wires on the centre of the screen. A second opening in the hemisphere is for the radiometer-carrier, in which Sabouraud-Noiré radiometric pastilles are used. H. W. P. Y.

REFERENCES.

173. *Radiation in Dispersive and Absorptive Media.* **M. Laue.** (Ann. d. Physik, 18. 3. pp. 523–566, Nov. 21, 1905.)—A treatise of the propagation of spherical electromagnetic radiation in media presenting dispersion or absorption or both. The paper is too analytical to admit of advantageous abstraction. [See also Abstracts Nos. 785 (1901), and 1227, 1592 (1905).] E. H. B.

174. *Deformed Electrons.* **A. H. Bucherer.** (Phys. Zeitschr. 6. pp. 833–834, Dec. 1, 1905. Phys. Inst., Bonn, Nov. 3, 1905.)—A mathematical discussion of electromagnetic theory, accepting the Heaviside ellipsoid form of the deformed electron. E. H. B.

175. *Atmospheric Electricity Observations at Newhaven after the Mont Pelée Eruptions,* 1902. **A. W. Wright.** (Monthly Weather Rev. 33. pp. 241–242, June, 1905.)—Observations of atmospheric electricity were being conducted in May, 1902, in the Sloane Laboratory. Some of the curves are now reproduced. On May 8, two hours after the eruption, nothing remarkable was noticed. But on May 9 the potential was negative and fluctuated much, while on other bright days fairly steady positive potentials had always been recorded. H. B.

176. *Production of Stratified Discharge by Influence Machine.* **H. B. Dailey.** (Scientific American, 93. p. 299, Oct. 14, 1905.)—The conditions for the production of very clearly defined striations with the Holtz machine are described. The most important point seems to be the avoidance of all sparking at loose contacts in the conducting circuit. If a Wimshurst machine is employed, two breaks in the circuit, in which brush discharges from points take place, are necessary. S. G. S.

177. *The P.D. for the Production of Kathode Rays.* **J. Malassez.** (Comptes Rendus, 141. pp. 884–886, Nov. 27, 1905.)—By a method indicated by Langevin, the author has tested experimentally J. J. Thomson's suggestion that the kathode rays have their origin, not at the kathode itself, but in front, and that the p.d. concerned in the production of the rays is not the total difference between the kathode and the region where the magnetic deviation is measured. The results are opposed to the suggestion mentioned. D. H. J.

178. *On Spark-gaps.* **R. de Valbreuze.** (Soc. Int. Élect., Bull. 5. pp. 641–673, Nov., 1905.)—A review of recent work on the subject. Reference is made to spark-gaps in vacuum tubes and to the use of mercury vapour lamps for this purpose. A few of the author's own experiments are described.

179. *Perturbing Influence of Electric Trams in Electrical and Magnetic Measuring Instruments.* **C. Maurain.** (Rev. Électrique, 4. pp. 257–263, Nov. 15, 1905.)—This paper deals with the causes of perturbation and their approximate magnitude in galvanometers, magnetometers, and industrial measuring instruments. It also goes into the question of the best means of minimising these disturbances, both with regard to the construction of the lines and the shielding of the instruments in the laboratory. E. C. R.

180. *Bolometer Adapted for Physiological Investigations.* **W. Colquhoun.** (Roy. Soc. Edinburgh, Proc. 25. pp. 827–830, 1904–1905.)—A few details as to the construction of an extremely sensitive Langley bolometer with illustrations of its uses.

181. *Auto-decohering Wave-detector.* **P. Lohberg.** (Ann. d. Physik, 18. 4. pp. 850–855, Dec. 12, 1905.)—The detector described in Abstract No. 1044 (1905) has been improved by the addition of some conducting metal filings to the electrolyte, making it now practically identical in principle with the anti-coherer type of responder due to de Forest and Smythe. Further constructional and experimental details are given and a theory of its action is elaborated. L. H. W.

182. *Direction of Permanent Magnetisation in a Metamorphic Clay.* **B. Brunhes.** (Comptes Rendus, 141. pp. 567–568, Oct. 2, 1905.)—From an examination of specimens taken from a clay metamorphosed by a flow of basalt of miocene age, situated near Pontfarein (Cantal), a uniform direction of magnetisation is found over a distance of 100 m., the dip, measured from a vertical drawn downwards, being — 75°. This appears to confirm Folgheraiter's conclusion [Abstracts Nos. 839 and 1039 (1899)] that, in the past, the magnetic inclination in Europe was negative. [See also Abstracts Nos. 1374 (1902) and 628, 629 (1904).] G. E. A.

183. *Harmonic Analysis of the Diurnal Magnetic Variations at the Cape of Good Hope and at Hobart.* **G. Heimbrod.** (Terrestrial Magnetism, 10. pp. 131–141, Sept., 1905.)—In these second and third parts [see Abstract No. 2028 (1904)] the author deals with the horizontal and vertical intensities and the total intensities. The paper is tabular. H. B

184. *Deductions from Magnetic Disturbances at Greenwich.* **C. Chree.** (Phil. Mag. 10. pp. 306–317, Sept., 1905.)—A discussion of three recent papers by Maunder in the monthly notices of the Royal Astronomical Society. R. S. W.

185. *Recent Advances in Röntgen Technique.* **C. L. Leonard.** (Roentgen Soc., Journ. 2. pp. 2–5; Discussion, pp. 5–6, July, 1905.)

186. *Protecting Masks for Radiotherapy.* **Caré.** (Archives d'Él. Médicale, 13. pp. 711–714, Sept. 25, 1905.)—For the protection of the healthy skin in radiotherapy of lesions of the head and neck, the author employs an accurately-fitting mask, specially made for each patient. The mask is composed of plaster of Paris, and is lined on both surfaces by thin sheets of lead, which are cemented to the plaster by paraffin. An aperture is cut in the mask over the area which is to be exposed to the rays. H. W. P. Y.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

187. *Relation between Electrolytic Conduction, Specific Inductive Capacity, and Chemical Activity of Certain Liquids.* **J. H. Mathews.** (Journ. Phys. Chem. 9. pp. 641–681, Nov., 1905.)—The electrical conductivities of a large number of substances, dissolved in the mustard oils, have been measured by the author. A few of the acids dissolve to form slightly conducting solutions, and the same is true of the amines. Some of the chlorides, iodides, and bromides dissolve to give slightly conducting solutions, but iodine, though itself a non-conductor, yields a fairly good conducting solution. Methyl silicate has been prepared and its specific conductivity and dielectric constant measured; it was also used as a solvent, as was the similar ethyl silicate. The results of Walden and Eggers have been revised, and data for the dielectric constants and conductivity of some new solutions have been measured. The results are given in the form of tables. It is found that in many cases chemical action is independent of any electrolytic phenomena, and that we may have various chemical actions of a decided character in solutions which are non-conductors of electricity. The Nernst-Thomson rule has been proved to have no foundation in fact, as the exceptions are as numerous as the confirmations. The exhaustive bibliography given is arranged alphabetically under the authors' names. [See also Abstract No. 522 (1902).] D. H. J.

188. *Absorption of Salts in Aqueous Solution and of Water Vapour by Quartz.* **L. J. Briggs.** (Journ. Phys. Chem. 9. pp. 617–640, Nov., 1905.)—As bearing on the question of the retention of soluble substances by soils, the author has examined the capacity of finely divided quartz to absorb the solute from various saline solutions. It is much less than that of amorphous silica, and for chlorides, nitrates, and sulphates is inappreciable. With hydroxides and carbonates the amount absorbed is relatively greater in very dilute solutions, and is more marked for the former, being apparently a function of the acid radical. The apparent absorption of potassium hydroxide from a N/10 solution is $1{\cdot}66 \times 10^{-5}$ gm.-mol. per sq. m., or 0·06 mgm. per sq. m. of surface. Quartz, like glass, condenses a water film on its surface from an unsaturated atmosphere, amounting to 26·6 mgm. per sq. m., which corresponds with a calculated thickness of film of $2{\cdot}66 \times 10^{-6}$ cm.; only part of this is liberated when the vapour pressure is reduced to zero at 30° C. The condensation of water vapour appears to be due to the attraction of the solid for the molecules of the vapour, and not, as concluded by Warburg and Ihmori, to the presence of soluble substances on the surface of the solid. W. H. St.

189. *Diffusion of Aqueous Solutions in Gelatine.* **P. Nell.** (Ann. d. Physik, 18. 2. pp. 323–347, Nov. 7, 1905. Inaugural-Dissertation, Bonn.)—(1) The diffusion of solutions through diaphragms with narrow, circular openings is proportional to the diameter of the openings. (2) Brown and Escombe's method of determining diffusion constants appears to be based on a defective theory, but may give correct results. (3) Gelatine has a considerable retarding effect on diffusion and on electrical conductivity, the

diffusion-constants and the ionic mobilities being influenced proportionately. (4) Ostwald's explanation of Liesegang's rings does not appear to be adequate. T. M. L.

190. *Artificial Diamonds.* **C. V. Burton.** (Nature, 72. p. 397, Aug. 24, 1905.)—Diamond is denser, and has less internal energy, than graphite, so that, if carbon can be crystallised at comparatively low temperatures, the minimum pressure sufficing to determine the diamond form will be lower than that employed by Moissan. The transformation temperature corresponding with atmospheric pressure lies somewhere between 550° C. and 700° C., or thereabouts. A molten alloy of lead with about 1 per cent. of calcium is capable of holding in solution a small proportion of carbon, either free or as calcium carbide, and if the calcium is eliminated from the molten mass—for example, by the action of steam, which converts it into hydroxide without attacking the lead—some of the carbon crystallises out. The crystals so obtained exhibit mostly faces of the octahedron, modified by the cube and dodecahedron, and are perfectly transparent and free from flaws. Approximate measurement of the index of refraction gives the value 2·43. T. H. P.

191. *Reduction of Metallic Oxides by Aluminium Carbide.* **J. N. Pring.** (Chem. Soc., Journ. 87. pp. 1530–1540, Oct., 1905.)—The author has investigated the interaction of aluminium carbide with metallic oxides and metals at the temperature of the electric furnace. Up to about 1,400° the carbide behaves as a strong reducing agent, but both Al and carbon are simultaneously oxidised, even when the carbide is in excess, and no separation of Al or carbon can be detected. A similar behaviour is noticed when the reactions are brought about in the mass of a flux so as to facilitate the agglomeration of the reduced metal. At higher temperatures selective reduction begins to be more apparent, the reduction being more and more brought about by the carbon of the carbide, with the result that alloys of the reduced metal and Al are obtained. Copper alloys containing up to 28 per cent. Al, and iron alloys with up to 49·6 per cent. Al, were obtained. These results are explained by the fact that at high temperatures alumina can be reduced by carbon, although at comparatively low temperatures Al is acted on by carbon monoxide to give carbide and alumina. It was not possible to fix or estimate the temperature at which reaction actually took place. Calcium carbide exhibits, in a smaller degree, a behaviour similar to that of aluminium carbide in the relative affinities of the calcium and carbon for oxygen at high temperatures. T. S. P.

192. *Quenching of Steel.* **Demozay.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 737–774, Aug., Sept., Oct., 1905.)—Gives numerous conclusions from the author's experiments on the effects of various factors upon critical temperature, including the rate of cooling, duration of heating near the critical temperature, dimensions of specimen, temperature of the heating chamber (other things equal, with increasing temperature of the furnace, the transformation in heating begins at lower, proceeds to, and finishes at, higher temperature), the critical points at various depths in a specimen. In cooling, the longer the heating has been continued and the more rapid the cooling, the lower will the critical point be; a shorter heating gives increased effect of rapid cooling. F. R.

193. *Rusting of Iron.* **W. R. Dunstan, H. A. D. Jowett, and E. Goulding.** (Chem. Soc., Journ. 87. pp. 1548–1574, Oct., 1905.)—The authors have proved that the aerial oxidation of iron can take place in the absence of CO_2, and that consequently the inhibiting effect of alkalies does not depend on their action in removing CO_2. H_2O_2 is probably formed as an intermediate product in the process of rusting, since many soluble salts, which decompose and therefore interfere with the existence of this substance, prevent the rusting of iron. Rusting only occurs if the fluctuations of temperature cause liquid water to condense on the surface of the iron. The part played by CO_2 must be regarded as subsidiary and not essential; it simply accelerates the process by the intermediate formation of a carbonate. The chemical action is probably represented by the equations: $Fe + OH_2 = FeO + H_2$. $H_2 + O_2 = H_2O_2$. $2FeO + H_2O_2 = Fe_2O_2(OH)_2$, and the analysis of a number of specimens of iron rust has shown that its composition may be fairly represented by the formula $Fe_2O_2(OH)_2$. The protection of iron from rusting by means of zinc is shown to be due to the liberation of hydrogen, from the zinc-iron couple, which tends to reduce any oxide of iron formed by ordinary atmospheric oxidation. In the ordinary atmospheric rusting of pure iron, however, it was proved that electrolytic action does not occur, and that no hydrogen is set free in the process. T. S. P.

194. *Lead and Sulphur.* **K. Friedrich and A. Leroux.** (Metallurgie, 2. pp. 536–539, Nov. 22, 1905. Communication from the Metallog. Laborat. d. k. Bergakad., Freiberg.)—The temperature-concentration diagram is worked out for a series of alloys containing from 0·6 to 13·5 per cent. of sulphur; this shows, besides a eutectic horizontal line at about 327° C. only a single curve, along which the body PbS separates, its crystallisation commencing at about 1,103° C.; the branch of the curve corresponding to the separation of pure Pb could not be detected with the appliances available to the authors. As far as it has been determined, the freezing-point curve shows no maximum, while the eutectic line shows no interruption, and the duration of eutectic crystallisation increases continuously. The authors therefore consider that the compounds Pb_2S and Pb_4S, which are stated by Bredberg to be formed when lead and PbS are melted together, are not formed under these circumstances—a conclusion which confirms the views of Percy on this point. This conclusion, derived from the diagram, is completely confirmed by microscopic examination of the ingots, nine photomicrographs of which are given. W. Ros.

195. *Aluminium-antimony Alloys.* **G. Tammann.** (Zeitschr. Anorg. Chem. 48. 1. pp. 53–60, Dec. 2, 1905. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Gautier and Campbell and Matthews have published freezing-point curves of Al-Sb alloys which are not in satisfactory agreement, although both conclude that the only compound formed is a very infusible one, AlSb. The freezing-point curve shows two maxima, but micro-sections prove that only one compound is formed. The cooling-curves further show the unusual feature of arrest-points at or near the freezing-point of Al for alloys with more than 20 per cent. Al, and near the freezing-point of Sb for the other alloys. The author explains these discrepancies on the assumption that the infusible compound AlSb is only *slowly* formed from the mixture of molten Al and Sb. He traces the process of solidification of such a system, and shows how the shape of the freezing-

point curve will depend upon the time during which the fused mass has been exposed to a high temperature; the second maximum, not corresponding to any definite compound, and the arrests at or near the freezing-points of the constituent metal are readily accounted for on this hypothesis. Further support for this view is obtained from experiments on an alloy containing 18·4 per cent. Al, which was exposed to temperatures of 715° and 1,100° C. for various periods of time, the cooling-curve being taken after each exposure; the results completely verify the hypothesis. Owing to the strong action of alloys rich in Al on porcelain, the hypothesis could not be readily verified for these alloys, but a similar series of phenomena have been found in the Sn-Al alloys by Campbell and Matthews, and in that case verification will be easier. W. Ros.

196. *The Iron-Carbon Equilibrium Diagram.* **G. Charpy.** (Comptes Rendus, 141. pp. 948–951, Dec. 4, 1905.)—From his experiments on high-carbon alloys, having especial regard to the rate of cooling, the author concludes that at about 1150° C. the eutectic of cementite and mixed crystals is formed; the eutectic of graphite and mixed crystals solidifies about 10° or 15° higher. The two are not formed successively in a given cooling, but one or other occurs according to conditions of experiment. F. R.

197. *Theory of the Heusler Alloys.* **C. E. Guillaume.** (Ind. Élect. 14. pp. 533–536, Dec. 10, 1905.)—Although the initial value of the permeability of the Heusler alloys is greater than that of cast iron, it is less than that of soft steel. The hysteresis loss also is at least as great, and they are much more costly. At present their main interest lies in the apparent difficulties of their theory, and so the author discusses them from the theoretical point of view with special reference to recent advances in the theory of fusion. In general, the fusing temperature of an alloy of two metals is less than the fusing temperature of either, but there are notable exceptions. Fusion is divided into true fusion and pasty fusion. In true fusion the body passes from the crystallised condition to the fluid condition. In pasty fusion the amorphous substance gradually passes into the liquid condition, the viscosity of the liquid being less the higher the temperature. In the case of alloys we only have true fusion at the turning-points of the curve of melting temperatures for the alloy. At these points there is total solidification, the alloy being "eutectic." The author concludes that if a certain crystalline form is essential to the magnetic state it is highly probable that the shape of the curves showing the loss of magnetism in alloys will be similar to that of the melting temperatures. This is found to be the case in practice. Just as the melting-points of alloys are generally less than the melting-points of their components, so the addition of an alloy to a magnetic metal in general lowers the magnetic qualities. In both cases, however, there are exceptions. Faraday has suggested that Mn and Cr, which belong to the same chemical group as Fe, Ni, and Co, are really magnetic. The temperatures of transformation of the latter three metals are very different, and so we are naturally led to think that they are generally not classed as magnetic metals simply because their transformation temperature is very low. Assuming this, we might hope to put the magnetic properties of Mn into evidence by raising the temperature of transformation. It seems that Al and Sn possess the property of raising, in certain cases, the temperature of transformation of the metals with which they are combined, whether these transformations are characterised by the passage from the

crystalline to the amorphous state (fusion) or to another crystalline state which possesses magnetic properties. The author had predicted from theoretical considerations that tin would have the effect of raising the temperature of transformation before it was proved experimentally. A. R.

198. *Ozone.* **R. Luther.** (Zeitschr. Elektrochem. 11. pp. 832–834; Discussion, pp. 834–835, Nov. 24, 1905. Paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell., Karlsruhe, June 1–4, 1905.)—It has already been found by Luther and Inglis that a solution of ozone in sulphuric acid acts as a monovalent oxidising agent, the p.d. given with a Pt electrode being 54 millivolts for a tenfold difference in concentration. To show that this is not due to ozone not following Henry's law, the author, along with Stuer, has determined the absorption coefficient of ozone in N/10 H_2SO_4. They have found $C_{solution}/C_{gas} = 0{\cdot}44$ at 0°, and $= 0{\cdot}23$ at 20°. When iridium electrodes are used, the potential is much smaller than with Pt electrodes, and for a tenfold difference in concentration the potential varies by 0·27 millivolt, showing that in this case ozone acts as a divalent oxidising agent. In the *discussion,* **Haber** stated that he believed the e.m.f. of the hydrogen-oxygen cell should be something over 1·2, and this was confirmed by **Nernst**. A. F.

199. *Potential of the Hydrogen-Oxygen Cell.* **F. J. Brislee.** (Faraday Soc., Trans. 1. pp. 65–74; Discussion, pp. 75–76, Jan., 1905.)—The author measured the e.m.f. of the cell consisting of two platinum electrodes charged with oxygen and hydrogen respectively in acid or alkali. The electrodes were either platinum sheets or glass tubes coated with platinum. After thoroughly cleaning, the electrodes were platinised. Precautions were taken to ensure the electrodes being voltaically equal. The gases were prepared in various ways, and were bubbled through the cell which was in two compartments connected by a tube, and was kept at a constant temperature. After starting the gases the hydrogen electrode soon became constant. The e.m.f. of the cell with N sulphuric acid as electrolyte became constant after 24 hours. Thus after 10 minutes the e.m.f. was 1·010 volts, reaching the value 1·082 after 24 hours, after which it slowly fell, becoming 1·054 in 30 days. Tests pointed to the formation of H_2O_2. Other conclusions arrived at were that addition of H_2O_2 reduces the oxygen potential, and that addition of persulphates or ozone increases the oxygen potential. The high potential observed with electrodes polarised by prolonged electrolysis is probably due to the presence of persulphuric acid and ozone. *Discussion.*—**N. T. M. Wilsmore** pointed out that according to Bornemann the oxidising substance in the neighbourhood of the oxygen electrode is not hydrogen peroxide. W. R. C.

200. *Counting Electrode Potentials.* **R. Luther, F. Krüger.** (Zeitschr. Elektrochem. 11. pp. 777–780; with Discussion, p. 780, and pp. 780–784; Discussion, pp. 785–787, Nov. 10, 1905. Report and paper read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell., Karlsruhe, June 1–4, 1905.)—On behalf of the unit commission of the Bunsen-Gesellschaft, Luther recommended that potential determinations be described in such a way that the experiments could be repeated exactly, and the results expressed as potentials of the half-cell against a normal electrode; this would be convenient for algebraical summations. Statements as to the more or less

hypothetical concentration of the ions, &c., were undesirable. The calomel electrode seemed, on the whole, to be preferable to the hydrogen electrode, except for determinations in acid or alkaline electrolytes. It would be best to take the potential of the normal electrode as zero; but two values were used, 0·560 volt (Ostwald) and 0·283 volt (Nernst). To avoid confusion as to the sign, Luther proposed to count any positive potential-difference against the normal electrode—be that the calomel, the hydrogen, or the fictitious drop electrode—as plus. Krüger referred to the analogy with temperature measurements and to the potential difference between the two liquids, to Planck's formula, and to Negbauer's table concerning this difference, mentioning that Nernst eliminates this term when possible by adding KNO_3 solution to both electrolytes. He was more for the hydrogen electrode as studied by Bose and Wilsmore. After remarks by **Ostwald, Nernst, van't Hoff, Luther, Lorenz, Haber, Bose,** the question, which is one of convenience and not of principle, was referred back to the commission. H. B.

201. *Electrolytic Determination of Zinc.* **K. Jene.** (Chem. Zeit. 29. pp. 803–804, July 29, 1905.)—A modification of the Foregger-Greiffenturn method, the principle of which is the electrolysis of a strong sodium hydroxide solution of the zinc. After separating any lead and insoluble matter by treatment with nitric and sulphuric acids successively, and filtering, solid sodium hydroxide (4–7 grms.) is added to the filtrate, which together with the washings should not exceed 100 cub. cm. When completely dissolved, the solution is transferred to a coppered platinum or nickel basin and electrolysed for 1½–2 hours with a current of 1 amp., and an e.m.f. of 3·8–4·2 volts, the temperature being maintained at about 50° C. and water added from time to time, to allow for evaporation and avoid exposure of the upper edge of the zinc deposit. The end is shown by hanging a small copper strip in the liquid in contact with the basin for some minutes, when no zinc should be deposited thereon. The deposit is first washed without interrupting the current, then with water and acid-free alcohol, dried in the air-bath for two minutes and weighed. It can be removed by very dilute nitric acid without affecting the copper. Good duplicates have been obtained by the method, the results also agreeing closely with those found by estimation as sulphide. The presence of Fe, Al, or Mn does not interfere with the process. W. H. Si.

202. *Contributions to the Study of the Polysulphides.* III. *Periodic Phenomena in Electrolysis of Polysulphides.* **F. W. Küster.** (Zeitschr. Anorg. Chem. 46. 2. pp. 113–143, Aug. 19, 1905. Chem. Inst. d. Univ., Berlin, June, 1905.)—During the electrolysis of aqueous polysulphide solutions there occurs with increasing voltage a point where periodic phenomena at the anode set in, consisting of a successive deposition and subsequent peeling off of a layer of sulphur. The deposition sets in very rapidly, and is attended by a sharp diminution of current and corresponding rise of bath-voltage. The author has studied the periodic variations of p.d. and current by means of hot-wire instruments, which were used in conjunction with Ostwald's "chemograph," and the paper contains a great number of the automatically registered wave-forms obtained under a variety of different conditions. The rise of bath-voltage is due to the increase of resistance caused by the insulating sulphur layer, and not to a true electrochemical change of electrode-potential. F. G. D.

203. *Influence of Ignition of Silver Voltameter on Value of Electrochemical Equivalent.* **G. van Dijk.** (Archives Néerlandaises, 10. pp. 277–283, 1905. Lab. de Physique de l'Univ., Groningen.)—The author has previously found the electrochemical equivalent of silver to be 0·011180 [see Abstract No. 1582 (1904)]. By further experiments on the effect produced by heating the silver deposit to 500–600° C. in a small Heraeus electric resistance furnace, whereby any included mother-liquor is removed, it is shown that no such inclusion could have occurred in the experiments of the former paper. F. G. D.

204. *Hering's Improved Electrolytic Process.* (Electrochem. Ind., N.Y. 3. p. 392, Oct., 1905.)—In C. Hering's process to prevent undesirable secondary reactions, the ions producing them are caused to form insoluble compounds at the electrodes. Thus in extracting Zn from an aqueous solution of zinc sulphate, the formation of sulphuric acid is prevented by using a spongy lead plate, with which the SO_4 anion combines. By transferring the lead plate with its coating of lead sulphate to another cell and using it as kathode, sulphuric acid is generated, and the electrode regains its spongy state. In the recovery of both the Zn and acid from discharged primary battery cells, the free acid is first extracted by electrolysing the solution between a spongy lead anode and lead peroxide kathode, the electrodes, which both become coated with lead sulphate, being then removed to another cell and reversed, to recover the acid. The solution from the first cell is then electrolysed between a kathode of Hg, or Zn amalgam, and a spongy lead anode.

W. H. Si.

205. *Electrolytic Formation of Hyposulphites.* **M. G. Levi** and **M. Voghera.** (Accad. Lincei, Atti, 14. pp. 433–443, Nov. 5, 1905.)—Sodium hyposulphite in yields varying from 9–16 per cent. was formed by the electrolysis of sodium sulphite in presence of sodium sulphide; the ionic sulphur liberated at the anode from the sulphide combines with the sulphite in the ordinary way. In some of the experiments a Puckall cell was used as a diaphragm to separate the anodic sodium sulphite from the kathodic sulphide, but the best yield was obtained in the absence of a diaphragm. The current varied from 2–4 amps. in the different experiments; the density from 16·6–33·3 amps. per sq. dm.; the e.m.f. from 6–10 volts. A temperature of 25° was found to be the most favourable. D. H. J.

206. *Can an Element form both Positive and Negative Ions?* **M. Le Blanc.** (Zeitschr. Elektrochem. 11. pp. 813–818, Nov. 17, 1905. Communication from the Inst. f. phys. Chemie and Elektrochemie d. techn. Hochschule, Karlsruhe.)—Experiments are described which show that tellurium has the highly characteristic property of passing into solution under similar conditions and in contact with the same electrolyte (caustic potash), whether acting as anode or as kathode; in other words, it is able to form both positive and negative ions. In consequence of this, when current is passed through caustic potash between Te electrodes, both electrodes dissolve, but with a Te kathode and Pt anode or *vice versâ*, the Te electrode dissolves, and a little latter Te itself begins to be deposited on the Pt. Experiments are in progress with reference to the action of an alternating current with Te electrodes.

T. M. L.

207. *Electro-chemical Equivalent in the Case of Metallic Conductors.* **M. Reinganum.** (Zeitschr. Elektrochem. 11. pp. 851–852, Nov. 24, 1905. Report read before the 12 Hauptversamml. d. Deutsch. Bunsen-Gesell. Karlsruhe, June 1–4, 1905.)—By an extension of the theory of Drude and Riecke of the conduction of the electric current by metals, the author shows that the charge on the carrier in metals is the same as that on a monovalent ion. In the case of copper, on the assumption that the free electrons carry the current, the value of "eN," where "e" is the charge, and "N" the number of electrons per unit volume, is found to be $3{\cdot}7 \times 10^3$ units, which is of the same order as if each gram atom of copper carried two ionic charges. In the latter case the charge per unit volume of copper is calculated to be $2{\cdot}7 \times 10^3$, which is in good agreement with the former number. T. S. P.

208. *Electrolytic Oxidation of Chromium Sulphate with Lead Peroxide Anodes.* **E. Müller** and **M. Soller.** (Zeitschr. Elektrochem. 11. pp. 863–872, Dec. 1, 1905. From the Elektrochem. Laborat. d. techn. Hochschule, Dresden.)—The electrolytic oxidation of chromic sulphate is hardly possible with Pt anodes, but easy with lead peroxide. Regelsberger (1899) believed that the peroxide acted chemically; others ascribed a higher "Ueberspannung" to the peroxide anodes; E. Müller and Friedberger [see Abstract No. 1238 (1904)], thought that in the similar oxidation of IO_3 to IO_4 the peroxide anodes had a catalytic effect. The authors find that this applies also to the oxidation of chromium alum in a normal solution of sulphuric acid. With smooth Pt anodes hardly any chromic acid is obtained; any traces of a soluble lead salt are deposited as lead peroxide on the anode, and the yield of chromic acid is at once increased; any chlorine ions present also favour oxidation. With anodes of platinised Pt the yield of chromic acid rises to about one-third that obtainable with lead peroxide anodes. The "Ueberspannung" of the PbO_2 anode is only slightly greater than that of the Pt anode, and the effect of the peroxide is catalytic, which would be compatible with Regelsberger's view of a chemical action such as—

$$3PbO_2 + 3H_2SO_4 + 2Cr^{\cdots} + 2H_2O = 3PbSO_4 + 2CrO_4'' + 10H^{\cdot}$$

A list of the literature on the subject is given. H. B.

209. *Sulphur, Selenium, and Tellurium as Kathodes.* II. **E. Müller** and **R. Nowakowski.** (Zeitschr. Elektrochem. 11. pp. 931–936, Dec. 15, 1905. From the Inst. f. physikal. Chemie and Elektrochemie. d. techn. Hochschule, Braunschweig.)—In pure water a kathode of selenium undergoes disintegration (Verstäubung) with the formation of red solutions containing colloidal selenium and hydrogen selenide. In alkaline solutions, as the concentration of alkali increases, the quantity of selenium decreases, and in N/10KOH a clear solution of the red-brown polyselenide is obtained. The valency with which the selenium enters into solution was found to be 0·7. In the case of sulphur (alkaline solutions) the valency varied from 0·57 to 0·89. In pure water at a voltage of 220 a sulphur kathode behaves similarly to one of selenium. A tellurium kathode gives both telluride and tellurium in N/10KOH, the valency being unity, but on increasing the concentration of the potash to 40 per cent. no tellurium is formed, and at the same time the valency increases to 1·3. The solution potentials were found to be 0·53 (?), 0·804, and 1·07 respectively, for sulphur, selenium, and tellurium. The results are shown to be in accordance with the theory of Müller and Lucas of kathodic disintegration, which is, that negative ions of low valency are primarily formed, and these then split up into ions of less and greater valency, of which one is the element. [See Abstract No. 1981 (1905).]

T. S. P

210. *Passivity of Nickel.* **M. G. Levi.** (Gazzetta Chim. Ital. 35. 1. pp. 391–405, June, 1905.)—The author has measured the loss in weight of a nickel anode and the voltage at the electrodes in 1·5 per cent. solutions of a number of salts at the ordinary temperature, and with an anodic current-density of 0·5 amp. per sq. dm. The results show that ordinary nickel dissolves quantitatively according to Faraday's law in solutions containing halogen salts, potassium cyanide, or sulphuric acid, whilst in sodium chlorate or nitrate, barium or cupric nitrate, sodium, ammonium, magnesium, or nickel sulphate, sodium carbonate, potassium hydroxide, or ammonium oxalate, it remains practically undissolved. In sodium acetate solution about 50 per cent. of the theoretical quantity of nickel dissolves. The other conclusions have previously been dealt with. [See Abstract No. 1839 (1904).]

T. H. P.

211. *Electrolytic Potential of Chromous Salts.* II. **A. Mazzucchelli.** (Gazzetta Chim. Ital. 35. 1. pp. 417–448, June, 1905.)—In investigating the conversion of chromic into chromous ions and *vice versâ*, the author uses tin electrodes in mixtures of chromic and chromous chlorides, sulphates, fluorides, and acetates. Cu and Hg electrodes give varying results, and with these metals and also with Sn higher potentials are obtained than with Pt. All determinations were made in a stream of CO_2. With two similar tin electrodes differences up to 0·06 volt were obtained. On adding fresh chromic or chromous salt the e.m.f. sometimes changes in the wrong direction at first, but afterwards assumes the normal value determined by the equation $E = K - A \log (C^{III}/C^{II})$. Similar irregularities are observed with Pt in H_2O_2 solution, but in this case the Pt acts catalytically, whilst tin has only a very small catalytic influence on chromous salts. For a mixture of chromic and chromous chlorides or acetates at 17–18°, with a normal Hg_2SO_4 electrode, the constant K of the electrochemical equilibrium is 1·04–1·06 volts, whilst for the fluorides it has the value 1·17–1·19 volts. With the sulphates less concordant values are obtained, but the most probable value for K is 0·98–1·03 volts. The oxidation potentials of chromous-chromic salts and also those of ferrous-ferric salts referred to the normal hydrogen electrode are given below.

	Chlorides.	Sulphates.	Fluorides.	Acetates.
Iron...............	− 0·705	− 0·657	about − 0·270	—
Chromium......	+ 0·38	about + 0·33	+ 0·51	+ 0·38

T. H. P.

212. *Experimental Study of the Three Parts of an Electrolytic Cell and the Relations between them.* **G. Hostelet.** (Zeitschr. Elektrochem. 11. pp. 889–904, Dec. 8, 1905. Inst. de Chimie générale, Liége, Aug. 1, 1905.)—The author has commenced the study of the behaviour of an electrolytic cell in action. This general behaviour he represents by the equation $\Delta E_t = \phi (U_e, p, T, \alpha, \varepsilon, \gamma)$, where ΔE_t is the total change in the energy at time t, p the pressure, T the temperature, U_e the potential, and α, ε, γ three arbitrary parameters which refer to the three parts of the electrolytic cell, and are more or less directly connected with the current density at each electrode. The author gives a theoretical discussion, supported by experiment, of the relationship between the different quantities and the laws which govern the specific action of the electrodes and the yield in an electrolysis. The paper does not, however, lend itself to a short abstract. A. F.

REFERENCES.

213. *Relation of Position Isomerism to Optical Activity.* IV. *Rotation of Menthyl Esters of Isomeric Nitrobenzoic Acids.* **J. B. Cohen** and **H. P. Armes.** Appendix by **R. P. D. Graham.** (Chem. Soc., Journ. 87. pp. 1190–1199, July, 1905.) —The authors' results confirm their previous observations on the effect of position isomerism on rotation [see Abstract No. 341 (1905)]. The *p*-nitro-group has the least and the *o*-nitro-group the greatest effect on the rotation. In the halogens previously studied the *o*-chlorine or bromine atom decreased the rotation; the nitro-group is here shown to increase it enormously. T. H. P.

214. *New Method for the Preparation of Neon, Krypton, and Xenon.* **S. Valentiner** and **R. Schmidt.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 38. pp. 816–820, July 27, 1905. Ann. d. Physik, 18. 1. pp. 187–197, Oct. 12, 1905.)—These experiments and the method employed are the same as described by Ramsay. [See Abstracts Nos. 2415 ((1901) and 1545 (1905).] E. C. C. B.

215. *Significance of Optical Properties as Connoting Structure.* **H. E. Armstrong** and **W. Robertson.** (Chem. Soc., Journ. 87. pp. 1272–1297, Aug., 1905.) —Attention is called to the importance of camphorquinone as a substance which can be studied not only by means of its refractive properties and magnetic rotatory power, but also by its colour and optical rotatory power. The importance of "co-operative effects," *e.g.*, when a ketonic group and a halogen are introduced into the same molecule, is specially emphasised. T. M. L.

216. *Boiling-points of Ammonia, Methylamine, Methyl Chloride and Sulphur Dioxide.* **H. D. Gibbs.** (Amer. Chem. Soc., Journ. 27. pp. 851–865, July, 1905.)—Using carefully purified material and improved methods, the author arrives at the following boiling-points: Ammonia, −33·46°; methyl chloride, −24·09°; sulphur dioxide, −10·09°; all at 760 mm. pressure; methylamine, −6·7° at 755·67 mm. T. H. P.

217. *Heats of Combustion and Formation of Volatile Organic Compounds.* **J. Thomsen.** (Zeitschr. Phys. Chem. 52. pp. 343–348, July 7, 1905.)—The author gives the numerical results of investigations on the heat phenomena of 120 organic compounds. T. H. P.

218. *Thermochemistry of Neodymium.* **C. Matignon.** (Comptes Rendus, 141. pp. 53–55, July 3, 1905.)—Results are given of measurements of the heats of formation and other thermochemical magnitudes of various neodymium compounds. T. H. P.

219. *Velocity of Crystallisation of Supersaturated Solutions.* **C. Leenhardt.** (Comptes Rendus, 141. pp. 188–189, July 17, 1905.)—The present author, working with sodium sulphate, sodium acetate, and sodium hyposulphite finds that *supersaturated solutions* exhibit exactly the same phenomena as were found by Tammann to take place during the crystallisation of superfused bodies. [See Abstract No. 1042 (1900).] D. H. J.

220. *Manometer Connections in Determination of Isothermals.* **H. Kamerlingh Onnes.** (Konink. Akad. Wetensch. Amsterdam, Proc. 8. pp. 75–77, Aug. 17, 1905. Comm. Leiden No. 94.)—The connections of steel to glass capillaries in the open manometer and other similar apparatus are now made by coppering the glass and soldering to the metal cap. A drop of mercury is introduced round the capillary to indicate any leak immediately. The screw connections and cocks in the gas connection system are now immersed in oil baths for the same reason. H. H. F. H.

221. *Electrical Conductivity of Solutions in Ethyl Bromide. Compounds of Dimethyl Pyrone with Acids.* Part IV. **W. A. Plotnikoff.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 37. No. 3. Section I. pp. 318–337, 1905.)—The ethyl bromide solutions of the two compounds of dimethyl pyrone with trichloracetic acid exhibit a marked electrical conductivity. D. H. J.

222. *Fusibility of Blast-furnace Slags.* **O. Boudouard.** (Iron and Steel Inst., Journ. 67. pp. 339–378; Correspondence, pp. 379–382, 1905. Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 441–470, June, 1905. Iron and Steel Mag. 10. pp. 53–58, July, 1905. Abstract.)—The experiments were made by noting the temperature of fusion of cones of different composition, Seger cones of similar shape being used as standards. It was found that the temperature of complete fusion was nearly the same as the temperature of softening except in the case of slags rich in Al and Si. Mixtures of Al_2O_3 and SiO_2 gave a very sharp curve with a eutectic temperature at 1,690° in a mixture of formula $10SiO_2, Al_2O_3$, the melting-point of silica being taken as 1,830°. Mixtures of lime with alumina or with silica gave less regular curves, and a number of compounds appear to be formed. Ternary mixtures were then examined, and the melting-points recorded on a triangular diagram. —**C. Richardson.** (Iron and Steel Mag. 10. pp. 297–300, Oct., 1905.)—Richardson criticises the values obtained for the melting-points. T. M. L.

223. *Melting-curve of* $Cd(NO_3)_2 . 4H_2O$. **N. A. Puschin.** (Jurn. Russk. Fisik.-Chimičesk. Obščestva, 37. No. 4. Section 1. pp. 382–392, 1905.)—This is the full paper corresponding to Abstract No. 1302 (1905). D. H. J.

224. *Molecular Theory of the Constitution of Steels.* **F. Gruardet.** (Rev. d'Artillerie, Paris, 64. pp. 199–222, 1904.)—An attempt to explain known properties —structure and strength—of steel by a mechanical concept of the particles and avoidance of such terms as allotropy. F. R.

225. *Properties of Saturated Hydrides of the Non-metals of the First Three Groups.* **de Forcrand.** (Annal. Chim. Phys. 5. pp. 289–307, July, 1905.)—The author records graphically the boiling-points, melting-points, heats of formation and molecular volumes of the hydrides of the non-metals occupying positions in the first three groups of the periodic system, in order to show how these properties vary with the molecular weight. T. H. P.

226. *The Systems:* $KIO_3-HIO_3-H_2O$, $NaIO_3-HIO_3-H_2O$, *and* $NH_4IO_3-HIO_3-H_2O$. **P. A. Meerburg.** (Zeitschr. Anorg. Chem. 45. 3. pp. 324–344, June 5, 1905.)—Isotherms are given for the above three ternary systems at 30°. In the system $KIO_3-HIO_3-H_2O$, the conditions are given for the formation of the two binary compounds, KIO_3, HIO_3, and $KIO_3, 2H_2O$. Contrary to the statement of Blomstrand, sodium tri-iodate, $NaIO_3, 2HIO_3$ is anhydrous; at 30°, no $NaIO_3, HIO_3$ is formed, but the pyro-salt, $Na_2O, 2I_2O_5$. In the system $NH_4IO_3-HIO_3-H_2O$, only the tri-iodate is found, the bi-iodate not being capable of existence at 30°. [See also Abstract No. 1102 (1905).] T. H. P.

227. *Caustification of Potassium Sulphate.* **I. Herold.** (Zeitschr. Elektrochem. 11. pp. 417–430, July 7, 1905.)—The author determines the solubility of calcium hydroxide at 120°, 150°, and 190° and the equilibrium isotherms for the reactions: $Ca(OH)_2+K_2SO_4=CaSO_4+2KOH$ and $Ca(OH)_2+2K_2SO_4=CaK_2(SO_4)_2+2KOH$, at 0°, 20°, 70°, 150°, and 190°. The technics of the caustification of potassium sulphate is explained. T. H. P.

228. "*Molecular Rise of the Lower Critical Temperature of a Binary Mixture of Normal Components.*" **J. J. van Laar.** (Konink. Akad. Wetensch. Amsterdam Versl. 14. pp. 108–116, July 14, 1905. Proc. 8. pp. 144–152, Aug. 17, 1905.)—A mathematical paper unsuitable for abstraction. The author discusses the results obtained by Centnerszwer and Büchner, and gives reasons for the doubling of the molecular formulæ of the solvents used by the above-named investigators. F. J. B.

229. *Electrolytic Production of Tartaric Acid.* (Soc. Chem. Ind., Journ. 24. p. 635, June 15, 1905.)—According to the process of C. Ellis (U.S. Pat. 789,269), tartaric acid and its salts are produced by anodic oxidation of saccharine solutions, in the presence of substances forming insoluble compounds with tartaric acid, these compounds being removed after formation from the field of oxidation. L. H. W.

230. *Syntheses by Means of the Silent Electric Discharge.* **J. N. Collie.** (Chem. Soc., Journ. 87. pp. 1540–1548, Oct., 1905.)—Under the influence of the silent electric discharge at the ordinary temperature ethylene gas not only unites with carbon monoxide to form compounds of an aldehydic nature, but also polymerises, yielding a series of complicated hydrocarbons, some of which approximate to the formula $C_{10}H_{20}$, while others have properties somewhat like those of indiarubber and a composition very near to $(C_5H_8)_x$. T. S. P.

231. *Rapid Electro-deposition of Copper.* **S. Cowper-Coles.** (Faraday Soc., Trans. 1. pp. 215–233; Discussion, pp. 233–236, Aug., 1905. Abstracts in Page's Weekly, 7. pp. 130–134, July 21, 1905. Elect. Rev. 57. pp. 235–236, Aug. 11, 1905. Elect. Rev., N.Y. 47. p. 549, Oct. 7, 1905.)—The paper consists of a brief summary of the various methods employed for increasing the rate of electro-deposition of copper. Details of the author's process of rapid revolution of the kathode and the means employed to ascertain the critical speed are given. [See also Abstract No. 301B (1904).] J. L. F. V.

232. *Electrolytic Reduction of Oxalic Acid.* (Electrochem. Ind., N.Y. 3. p. 392, Oct., 1905.)—By E. v. Portheim's process glyoxalic acid, its esters, and amides are prepared from compounds containing the oxalyl group (C_2O_2), by solution in dilute sulphuric acid in the kathode compartment of a diaphragm cell, and electrolysis at a low or moderate temperature. W. H. SI.

233. *Application to Electrolytes of the Hydrate Theory of Solutions.* **T. M. Lowry.** (Faraday Soc., Trans. 1. pp. 197–206; Discussion, pp. 206–214, Aug., 1905. Elect. Rev., N.Y. 46. pp. 943–944; Discussion, p. 944, June 10, 1905.)—A *résumé* of the subject, showing how the apparently simple phenomena of electrolytic dissociation are complicated by hydration of the constituents, and by complex formation. The author makes no reference to the papers of Werner and Abegg dealing with the same subject. F. G. D.

234. *Abnormal Anodic Polarisation.* **E. Müller** and **A. Scheller.** (Zeitschr. Anorg. Chem. 48. 1. pp. 112–128, Dec. 2, 1905. Elektrochem. Laborat. d. techn. Hochschule, Braunschweig.)—The paper deals with the abnormal anodic behaviour of the halogen elements F, Cl, and Br. For details the original paper must be consulted, as the paper is not suitable for abstracting. [See also Abstracts Nos. 1156 (1901) and 1238 (1904).] F. J. B.